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THE TRANS-ATLANTIC BALLOON VOYAGE.

THE project of crossing the Atlantic with the air-ship, which is just now attracting so large a share of public attention, is one which, from its unusual and to some extent speculative character, is surrounded with much interest. Aside from these considerations, however, the possibilities attaching as results to the successful solution of the problem of trans-atlantic aerial passage, opening as it does a wide field for the exercise of the imagination, adds to the projected voyage a peculiar interest of its own.

The feasibility of accomplishing a journey of three thousand miles with the balloon is not a notion of to-day, but has several times been broached by aeronauts and others within the last thirty years or more. The English aeronaut, Green, it seems, as early as 1840, speaks of the proposition, and argues, for certain reasons to be specified hereafter, in favor of America as the proper starting-place for such a voyage; while in this country the idea has been repeatedly urged and defended by the veteran aeronaut, John Wise, who, if no misfortune intervenes, may shortly have the opportunity of realizing that which he has so long and ably championed.

Although at first sight it would seem that a project apparently so venturesome had originated from the enthusiasm of the professional aeronaut, it will nevertheless be found, on serious reflection, to possess legitimate claims to consideration. These claims consist of facts and inferences drawn from the life-long experience of the leader of the projected enterprise—facts and inferences which, it is moreover held, are substantiated upon theoretical and practical grounds by meteorological science.

According to Prof. Wise, the possibility of successfully accomplishing the transit of the Atlantic with the balloon is substantiated by the existence in our latitudes, at greater or less heights, of a constant easterly air-current, in which—when once attained by the air-ship—it would only be necessary to remain by good management and previous proper provision of the balloon, in order to be wafted rapidly and safely to the shores of the eastern continent. This assertion completely involves the whole problem, and upon its verification is its success wholly dependent.

Laying, for the present, entirely aside the testimony of aeronauts of long experience in their profession—who almost unanimously testify to the effect that at varying altitudes, according to season, their air-ships have been driven eastwardly—a phenomenon of such general bearing cannot fail, if genuine, to have its origin in some vast general cause or causes predicable in advance from meteorological premises. That the proposition does receive such theoretical verification it will be attempted to be shown in what follows.

The winds, or air-currents, have their origin in the disturbance of the equilibrium of the atmospheric ocean—this disturbance being produced by the unequal heating which it receives on various parts of the earth's surface. The bodies of air which have become heated to a higher temperature than that surrounding it, expand, become lighter, and rise, causing an indraught of air from every quarter surrounding the centre of disturbance, until the equilibrium is again disturbed. The equatorial heat-belt, as the strip of the earth's surface in the immediate neighborhood of the equator is termed, may therefore be regarded as the source or origin of the atmospheric currents. It is here that the sun, pouring down its fiercest rays, heats earth, air, and water to a degree unknown elsewhere. The air thus heated rises, within a belt of some 10° or 11° of latitude, forming what is known as the zone of calms. The constant upward displacement of a vast body of air necessitates its renewal from other quarters, to meet which the cooler air from the northward and southward moves in towards the area of disturbance. The heated air which has thus ascended finds its equilibrium at an altitude dependent upon its temperature, and finally separates into two great streams—the one flowing towards the north, the other towards the south, gradually cooling and descending as they recede from their places of departure, until they are again drawn into the circuit which flows back towards the equator.

This, simply and crudely stated, is the system by which the atmosphere is kept in constant circulation; and were there no disturbing causes to modify it, the science of meteorology would be without mystery. Were the earth without a motion of rotation, the direction of these currents would be clearly due north and south upon the meridians; but its rapid rotation impresses upon them an easterly or westerly deflection, according as they are approaching towards or receding from the equator. The cause of this deflection is simple. The axial rotation of the earth from west to east is most rapid at the equator, where it possesses an easterly motion of about one thousand miles per hour; and this rotary motion becomes gradually less and less towards the poles, where it is nothing. It is clear that those bodies of air which have been for some time in the neighborhood of the equator have acquired the rapid easterly motion of the earth at this location, and that in passing northwards or southwards towards the poles will, in virtue of that perfect freedom of motion which the gases possess, constantly have a greater amount of easterly motion than the earth itself in those regions into which they successively arrive. This will be clear when it is remembered that the earth is gradually losing its easterly motion from the equator towards the poles, and that the moving air-masses lose their motion only slowly. The consequence of this fact is, plainly, that in the higher regions of the atmosphere, from the equatorial heat-belt northwards and southwards, there should exist a constant air-current, blowing towards the north-east in the northern hemisphere, and towards the south-east in the southern.

With the return-currents from the poles, however, the opposite conditions hold good. They originate in regions of the earth where its eastwardly rotative motion is trifling, and flow towards the equator, where the eastwardly motion is constantly augmenting; and therefore having constantly to acquire this continual excess of eastwardly motion as they progress, they are thrown to the westward. In other words, they do not take on the increasing easterly motion of the earth at the successive parallels to which they arrive with sufficient rapidity, and consequently lag somewhat behind the earth as they descend or ascend the parallels towards the equator, and thus from the effect of the earth's more rapid motion are thrown towards the westward.

The height to which the air-ship must ascend in order to encounter the easterly current will depend upon several conditions, the most important of which are the latitude of the place of its departure, the season of the year, and the presence or absence of any disturbing element due to local causes. It is dependent upon the latitude, since the equatorial currents passing towards the poles are gradually cooled and descend, conflicting at moderately high latitudes (say 30° to 40°) with the return-currents from the poles, and producing the wind region often designated as the zone of the variable winds. It is dependent upon the season, since the annual apparent northerly and southerly passage of the sun causes a disturbance of the various wind zones; their limits contracting and expanding in obedience to this change in the sun's position. It is very largely dependent on local causes, by which term is meant to be included the disturbing element introduced into the problem by the presence of large bodies of land, which may act either as condensers of the sun's heat, as in the case of vast extended tracts of comparatively level country, which often reproduce in higher latitudes the conditions which rule about the equator, forming areas of aerial expansion, which induce an indraught from all quarters about it, disturbing the simple system of atmospheric circulation before referred to; or where vast bodies of elevated land are present the very opposite effect may be brought about.

It is very probable, however, that this last-named disturbing element may be to a considerable degree avoided by making the place of departure for the proposed trans-atlantic voyage some point near or upon the sea-coast, since upon the ocean it may be reasonably expected that these adverse conditions will either be altogether absent or at least reduced to a minimum. With regard to the conditions already referred to as likely to modify the direction and constancy of the air-currents, it must be confessed that the facts at disposal are hardly sufficient to warrant a positive statement of difficulties in the way of the aeronaut. It is probable that, starting from the latitude of New York, the venture would be more likely to result successfully, if undertaken in the fall of the year, than in the spring or summer; for the reason that, with the sun north of the line, the continent of North America receives an unusual amount of heating, rendering its vast expanse of land a region of barometric depression, by which a considerable disturbance of the constant currents may well be feared—since the overheated continent draws its supplies of air from all quarters upon its surface, rendering it probable that the eastwardly current will only be met with at a very great height. After the vernal equinox, and before the autumnal, this disturbing element would in all probability prove to be a serious one; while after the autumnal equinox, and before the vernal, the probabilities are, upon theoretical grounds, that the conditions will prove most favorable for the venture.

This train of reasoning has, however, but an imperfect basis of solid observation upon which to rest. A dozen positive observations, recorded by an intelligent aeronaut, and verified, will outweigh whole Alps of theoretical reasoning. Prof. Wise, who is a conscientious and, at the same time, remarkably acute observer, and one able, from his scientific knowledge, to generalize correctly from his observations, asserts in the most positive terms, that in a ballooning experience extending over nearly forty years, and over a considerable portion of our country, he has, with rare exceptions, been able to reach an easterly current. He writes: "My aerial experience is, that in early summer—May, June, and July—my trips were from south-west to north-east; in October and November, from north-west to south-east. I have, however, found it necessary to get very high in August and September to find any strong current." These statements of the veteran aeronaut conform generally to what, upon theoretical grounds, might have been anticipated; while both theory and practice indicate pointedly that mid-summer is the season of all others most unsuited to attempt the hazardous experiment of crossing the ocean with the air-ship.

Upon the proper construction, outfit, and management of the air-ship itself, upon which—aside from the difficulties which nature has interposed—the success of the experiment is also largely dependent; it being taken for granted that the skill and forethought of the builders and the funds at their disposal should be ample to provide forall such contingencies as are reasonably controllable.

It would, indeed, be presumptuous in a non-professional critic to venture suggestions or advice upon such a subject. One suggestion, however, in this connection, seems to be sufficiently free from the character of a professional topic, and to be, at the same time, of sufficient importance to warrant commenting upon. The suggestion referred to is the propriety, and perhaps necessity, on the part of the gallant aeronauts, of having a considerable *margin* of buoyant power over and above what they deem it probable they will require. This excess of buoyant power, which will also necessitate the carrying of a corresponding excess of ballast, may at first sight seem useless, but it appears to our mind to be a consideration of first importance; while, even supposing that good fortune should land the voyagers upon the shores of the eastern continent in a few days, the fact of an error committed on the side of safety will never be urged against them. With the air-ship, the difficulty in its manipulation will doubtless be that of properly controlling its vertical movements, which, in order to keep in the horizon of a favorable air-stream, when this is once attained, will require the judicious exercise of professional skill. In this connection, the difficulty to be provided against is that resulting from the constant loss of buoyant power by the steady escape and adulteration of the gas—the first by positive leakage, the second by osmose. The trouble to be anticipated on the latter score will probably prove to be trifling, but the first-named difficulty must be liberally provided for by the provision of a very considerable margin of buoyant power; so that even a constant loss of, say fifty pounds of lifting power per hour for at least six or eight days, can be suffered without impairing the buoyancy of the vessel, or drawing too severely upon the resources of the aeronauts, with the aid of which they may be able, in case of any sudden emergency, to rise to a considerable height. In addition, the possibility of meeting with adverse or inconstant currents, as well as the possibility of being driven at times in the wrong direction, are contingencies by no means to be ignored; and the possible interference of one or more of these adverse conditions demands, also, that liberal allowance of gas be supplied, so that the surplus buoyancy of the air-ship may be depended upon to keep it afloat for double the time which the aeronauts anticipate will be required to accomplish the voyage.

If an air-vessel is constructed of sufficient size to possess, when inflated, a margin or excess of lifting power as great as has been urged in the foregoing, there is a reasonable probability that it will safely reach the other side.

While the work of preparation for the voyage is going on, it might not be amiss to test by actual trial the question of the existence of the much-debated easterly air-current over the ocean, by a series of experiments with toy-balloons of rubber, inflated with hydrogen, and sent off from the decks of some of the ocean steamers. A number of such trials could readily be made, and a log of the results would do away with a great amount of useless argument which the subject of the balloon enterprise is calling forth.

The balloon itself and its many appurtenances, it would appear, are being constructed with great care, and there is every reason to believe that the forethought of the aeronauts themselves, and the enterprising spirit of the Graphic company, which has fathered the experiment, will leave nothing undone which will involve its success. What may be the result, immediate or prospective, of the successful accomplishment of this novel and hazardous attempt—who may tell?

THE WATER-WORKS OF PARIS.[*]

PARIS now receives water from the rivers Seine, Ourcq, and Marne, which furnish a daily supply of 281,500 cubic mètres,[†] (74,500,000 gallons), and from the sources of Arcueil and Dhuis, together with the artesian wells of Grenelle and Passy, which yield 33,600 square mètres (9,000,000 gallons) per day. To this must be added what is obtained from the Northern springs, which, at the least, perspire (that is the right term) 216 cubic mètres (57,000 gallons) per day. Thus 315,316,000 litres (83,500,000 gallons) of water are furnished daily to the Parisian population, which can with all comfort use it for drinking, bathing, domestic uses, cleansing culverts, and supplying engines and fountains.[‡]

We are far advanced from the time when the rude pumps of Challiot excited the admiration of Mèrcier, but we do not expect to rest here. Immense additional works, commenced in the spring of 1868, but interrupted by the events of 1870, are now (May 15, 1873,) being pushed with much vigor, and will yield in a few months a daily increase of 100,000,000 litres (26,412,500 gallons) of pure and limpid water. To follow an order that might be called chronological, it will be necessary to visit first the Northern springs—that is, those flowing to Belville and Près-Saint-Gervais. These are, however, not really springs, but water gathered drop by drop from the ground. The monks of Saint Laurent and Saint Martin had observed that the rain which fell on the hillsides did not all descend to the valleys, and hence they concluded that the earth absorbed the larger portion, which, penetrating the different layers, disappeared in their depths. They determined to unite these partial drippings—to take the spring, so to speak, as it was being formed, and to stop its passage to those subterranean sources, to reach which the means had not been discovered in their day. On the northern heights of Belville and of Près-Saint-Gervais, the monks constructed what were called "pierrées," a sort of conduit, generally square, and built of large stones loosely joined, having also occasional openings. The water filtered through the joints, and was conducted into a small canal, whose sides and bottom were lined with glazed ware, "imperméable," as it is named by the makers. This is the whole system, which is simple enough, but very defective. Such artificial springs, being fed only by the humidity of the ground, are subject to variations far greater than natural sources. With them you know not upon what to rely. After a rain the saturated earth delivers a great quantity of water into the conductors; but, if the sky be clear, the north-east winds carry off the clouds, and the earth be dry, the reservoirs also will be dry, or very nearly so.

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[*] Translated for the American Exchange and Review from *Revue des Deux Mondes*.

[†] French measures used in this paper: Litre, 61.016 cubic inches = 2.113 American pints; hectaire, 2.471 acres; mètre, 39.368 inches; cubic mètre, 61023.50 inches ÷ 232 = 263 gallons; centimètre, .39371 of an inch; kilomètre, 3280.709 feet = .62135 mile; kilogramme, 2.205 lbs. avoirdupois. In the Reaumur scale zero is counted at 32° Fahrenheit, and 80° are allowed between that and the boiling point.

[‡] By the kindness of Dr. W. H. McFadden, chief engineer, we are furnished with the following figures, showing the present *daily* capacity of all the water-works of Philadelphia, which it will be interesting to compare with the above.

Fairmount, 42,000,000 gallons; Schuylkill, 26,000,000 gallons; Belmont, 18,000,000 gallons; Roxborough, 5,000,000 gallons; Delaware, 12,000,000 gallons. Total, 103,000,000 gallons. Proposed works at Frankford, 10,000,000 gallons.

The official report of the chief engineer of New York city states the daily average quantity delivered by the Croton aqueduct, New York city, to be 115,000,000 gallons.

Professor Frankland reported to the House of Commons that the daily quantity of water supplied to London by the eight companies, during the year 1871, was as follows: Wholesome water, from deep wells and springs in chalk, 20,000,000 gallons; impure water, from polluted rivers, 87,000,000 gallons. Total, 107,000,000 gallons. But of the pure water, 12,500,000 gallons (the New River company's share) are allowed to mix with 11,000,000 gallons of polluted water before distribution, leaving only 7,500,000 gallons strictly pure water daily for the city of London.

In moist winters, and during the rainy month of March, the mètre of Près-Saint-Gervais passes about 250 litres (66 gallons) per minute. In summer it rarely exceeds 90 per minute (23¾ gallons); and sometimes, in very dry seasons, falls to 40 (10½ gallons) per minute. The water thus collected is not of the best quality, being charged with carbonate and sulphate of lime; it is disagreeable to the taste, unsuited for cooking vegetables, which it hardens, and is refractory with soap. At intervals there are erected chambers, or receptacles, where the conduits empty, and the water receives a new direction towards the fountains it is intended to supply. At Belville it is conducted by a leaden trough, upon which it leaves a calcareous deposit. These old conduits are not handsome: built with a very low arch, and of sad and miserable appearance, they resemble superannuated culverts; a dirty white vase encumbers each opening or "barbacan," and all the surroundings are in a very untidy condition. To make amends, the monks have endeavored to give the reservoir (regard) a monumental appearance; it has the air of a mausoleum, and a kind of open rotunda, surrounded with light columns, surmounts it, apparently giving some value to the name, "The Lantern," inscribed over the entrance. The building is singularly formed of great hewn stones, which, on the roof, have the appearance of immense tiles. The architecture is massive and rude, and the moss and lichens growing on the walls give a funereal aspect to the building.

The reservoirs of Près-Saint-Gervais are constructed in a similar manner, and rise from the hillsides like tombs among ruins, for they almost touch the fortifications, and are surrounded by the debris of the small houses which it was necessary to demolish, because lying within the military zone when the German forces held the heights of Raincy. All these reservoirs have at times been put in good repair; the most important improvements were during the last century; that of Bernage has the date of A.D. 1743. The canals of Près-Saint-Gervais meet at a fountain, which is situated in the centre of the village; it bears an inscription stating that it was erected in the reign of Louis XIIII (*sic*), whilst Le Féron was provost of traders. Here, after having climbed a wooden stairway in the interior, you arrive at the mètre-chambre. Small semi-circular basins of lead are placed one above the other, and by a series of falls, properly arranged, give to the water the normal direction; it also passes through holes, one inch in diameter, which aid in the measuring. Small square receptacles, pierced with a narrow opening, representing one or two lines, ($\frac{1}{12}$ of an inch), determine the quantity of water allowed to certain private concessions. It is the old meter of our fathers, and doubtless will some time be removed, but let it not be destroyed. It is a curious specimen of ancient usage, and as such should find a place in one of our museums. The Parisians now consider this water—the collection of which was so highly appreciated by a former age—as not suitable for drinking, especially as they have abundant supplies of pure water from other sources. Formerly fountains were built to receive it, and Francis I solicited some for the use of one of his favorites. Its ancient glory is departed, for it is now mostly used for washing out the culverts. Although unsuited for domestic use it is not lost, being used in the streets of Paris when they are swept, and it assists the public hygiene by cleansing the pavements and gutters and sprinkling the streets.

The water from the Northern sources, which formerly were called the "Royal springs," has also lost its importance at present, and enters but little into consumption; they yield only about 1,000,000 litres per day (264,125 gallons). They were furnished by the districts Rungis, L'Hay, Cachan, and Arcueil, and were from surface drainage. The aqueduct which brings this water has a grandiose appearance where it crosses the valley of Bièvre, and would not disgrace the Roman campagna. It was built by Jacques de Brosse, who certainly erected durable work. It has a length of 400 mètres (437½ yards) of arches, and its appearance lends an imposing effect to the landscape. The immense old stones bear the craftman's marks of the workmen who quarried them, and who could not write, such as the chisel, the mallet, and the compass. Like the antique temples on which the Christians built churches, the aqueduct of Arcueil serves in more than one place as base for a gigantic structure, which, at the lower part of the valley, is 18 mètres (59 feet) higher than the old ruin. The hour is not far in the future, however, when all these sources, united with so much labor, will hear a new stream flowing overhead, at the rate of 100,000,000 litres (26,412,500 gallons) in twenty-four hours. The aqueduct of Arcueil supports the aqueduct of the Vanne. The work of the architect of the Medici sustains the work of our engineers. The latter have with much ability used the ancient monument of Jacques de Brosse to support the immense construction which guides the aerial canal across space, leading to Paris the water from the Champagne plains.

During the siege there was an ample supply of water at Paris, as the steam-pumps on the Seine worked day and night. At present there are six—Port-à-l'Anglais, Maisons-Alfort, at the quai d'Austerlitz, Auteil, Saint-Ouen, and Chaillot. The last is the oldest, and is similar to all the others. It consists of two enormously heavy pistons, each moved by a steam-engine of 150 horse power, and which, reposing a few moments when raised to allow time for the water to enter the cylinders, descend by their own weight, and drive the water to the reservoirs of Passy. During twenty-four hours the average consumption of coal for each machine is 11,700 kilogrammes, (25,798 lbs), and by it 21,709 cubic mètres (5,709,467 gallons) of water are pumped to the reservoirs. There is no need of steam pumps to drain the river Ourcq, for it comes very comfortably in the canal laid by Girard, commencing at the dock of La Villette, near where many large vessels are constantly lying. The water before entering the canal passes through gratings covered with wire screens of same width as the openings, so that, though the water is not here filtered, it is relieved from the grosser impurities. The gratings are usually changed three times per day, and to view the dead dogs, remains of vegetables, twigs, leaves, and other impurities held back, is sufficient to enable us to appreciate this screening process. In the autumn, however, at the time of the falling of leaves, it is necessary to change the screens every half hour, day and night. The water of the Ourcq, after passing through a short covered canal, appears in an open, square basin, furnished with floodgates, and a heavy wheel, with ample buckets or vanes. This is the hydraulic meter. It is found that 11 mètres, 200 litres (2,945¾ gallons) of water must pass the wheel to give it one revolution, and a counting machine on the wall records the number of turns. From thence it is carried in an under-ground gallery, having the canal in the centre, to two reservoirs, which hold each 9,000 square mètres (2,367,000 gallons) at the boulevard Batignolles, at the angle of the rue du Rocher; the whole length of the galleries being 4,238 mètres (4,635 yards). It is necessary to purify the reservoirs every two or three months. The contents are let off through a culvert, the foul bottom cleansed, and the water again collected.

During the siege the water of the Ourcq ceased to flow on the 23d of September, 1870, the canal having been cut by the Germans in the forest of Bondy, but there were other resources that proved sufficient. The aqueduct "de ceinture" and the reservoirs of Monceau were supplied by the Seine, the Marne, and the artesian wells of Passy. The aqueduct of Ourcq was fully repaired in March, 1871. Under the government of Louis Philippe all these waters we have described seemed insufficient for the regular supply of Paris, and it was decided to draw from other sources; but, in this case, instead of going to the well-known rivers or springs, the endeavor was to find the water, which, falling on the elevated plateaux of Champagne, forms a subterranean stream, flowing beneath the basin on which Paris is situated. It was decided to sink an artesian well, Arago having affirmed that the presumed sheet of water could be attained without insurmountable difficulties. The place chosen for operations was the court-yard of the abattoirs of Grenelle, and M. Mulot, who undertook the work, gave the first stroke with the probe, December 24, 1833. The scientists did not hesitate; the geological theory proved to them that they must succeed, but it was not so with the public, who were unceasing in their ridicule of the enterprise. In vain M. Mulot declared that he expected to bore 400 mètres (1,312 feet) at least, of the different strata before striking water. Everyone laughed at his perseverance, or rather his obstinacy, and there were not a few who derisively said, that "ministerial blunders sacrificed the revenues of France to chimeras." Even the theatres took up the subject, and in the usual "revue" at the end of the year the principal personages were M. Mulot and son. Nevertheless the work advanced, but not without difficulties, and it was soon found that this effort was no exception to the accidents that usually attend this kind of work, and which are always the more serious the greater the distance attained.

In May, 1837, having reached a depth of 380 mètres, (1,246½ feet), and having passed the *terrains de transport*—the limestone strata—and when amidst an enormous bank of compact chalk, mingled with silex, a piece of the boring rod, 80 mètres (262½ feet) long, with the augur at the end, parted and fell to the bottom of the well. The rod was broken into several pieces, and it was necessary to remove this debris. This was only effected by finding each of the broken pieces and cutting a spiral screw on the end. A rod with a corresponding female spiral was then fitted, and the broken pieces withdrawn. To perform such a task, groping blindly at the depth of 1,246 feet, was no easy task. It was accomplished, however, but required a labor of fifteen months. The depth of 548 mètres (1,797½ feet) was reached, notwithstanding other accidents, which would have discouraged a man less convinced than Mulot; and the public still continued to shrug its shoulders, when, on the 26th of February, 1841, after eight years' work, the probe suddenly fell a long distance. Was it a new misfortune which this time would perhaps be irreparable? No, it was that water was found, which, ascending the tube, burst foaming from the opening to the height of 60 feet. The victory rested with the theory as foretold by science, and with the courageous perspicacity of the engineers. The water on reaching the light had a temperature of 27.67° Reaumur, (93° Fahr.). This was a success that soon degenerated into infatuation. At once the public began to dream of warm springs, curing all sorts of diseases. To ridicule succeeded an enthusiasm, which happily produced little effect, as each one proposed new wells.

A building and reservoir cover the spot where the spring arose. The water received by a conductor is led a short distance to the middle of the square Breteuil, where it meets two tubes placed vertically to break the force of ascension. This water-chateau is built of cast iron, is 43 mètres (141 feet) in height, and is crowned with a sort of cupola, ornamented with three galleries, having open fronts, reached by a circular stairway; the whole edifice resting on a large base of hewn stone. With great pretension to lightness, it is very heavy and displeasing to the view, resembling much those *chefs d'œuvre* of confectionery called *pieces montées*.

On entering one is surprised to find that the springs of the arches which form the interior of the basement are disjointed, and the cement with which they have been repaired scarcely hides the large cracks. This is the effect of the wind, which, when it blows with violence, causes this immense corkscrew to vibrate, and such a mass, if in motion, would crush the most solid foundation. This, however, is not a matter of very great importance, as several centuries will probably elapse before all this ponderous iron edifice will some day be levelled by a tempest. The reservoir which receives the subterranean spring is 42 mètres (138 feet) above the ground, and the water arrives there pure and limpid in a large sheet resembling an immense uncut diamond. It is agreeable to the touch, lukewarm, and as it were velvety, (*savonneuse*), but emits a very decided odor of sulphuretted hydrogen. The tank receiving the water is coated with a yellowish cream which is sulphur; the water containing quite an appreciable quantity disengaged in the receptacle, while it receives from the air the requisite quantity of oxygen. It descends by two pipes, which lead it to conduits ending in the reservoir of Vielle Estrapade, where, however, it never arrives, as the connections to private houses drain it as it passes.

At first the volume of water was large, but the well now yields actually only 374 cubic mètres (98,362 gallons) per day, which is to be regretted, for this water is excellent and of incomparable softness. The deep subterranean sheet, where the tube found the spring, has not diminished in importance, but M. Constant Say has drawn very largely on it in sinking the wells for his sugar refinery at the boulevard de Gare, and the artesian wells of Boulogne also draw from the same, so that the wells of Grenelle are impoverished by their neighbors. What will be the result when all the others now commenced shall reach the underlying water-sheet?

That of Passy, 586 mètres (1,923 feet) in depth, furnishes 500 to 600 cubic mètres (about 145,000 gallons) per day. The water, which has a temperature of 28½° R., (93° F.), is exclusively reserved to feed the artificial rivers and fountains of the Bois de Boulogne. At present two new wells are in progress, one at Butte-aux-Cailles, now 536 mètres (1,758 feet) deep; and the other at La Chapelle, 677 mètres, (2,221 feet). A subterranean valley has been encountered, and it is hoped that at the depth of 700 mètres (2,300 feet) the water-sheet of Grenelle will be struck, and at 720 mètres depth (2,362 feet) the sheet lying still lower, for which search has so long been made.

It is even probable that still deeper borings will be made to the *jurassique* strata, when the water to be obtained may exceed all expectations. On the well at La Chapelle work has been progressing for a long time. The preparatory arrangements were made May 6, 1863, and the first stroke June 1, 1865, and at present tubes are being put down to prevent constant caving in of the sides, which has stopped all advances, and which difficulty has been vainly combatted for three months. The boring tool alone weighs 24,000 kilogrammes, (52,920 lbs.), lifted by a steam-engine of 26 horse power. Difficulties that would have stopped Mulot are now but as child's-play, for the science of artesian-well boring has made immense progress, and no matter how great the depth the work goes on with as much precision as if at the surface. A foreman said, jestingly, "At 600 mètres (1,968 feet) we can shave a man without drawing blood." This is a slight exaggeration, but very extraordinary exploits are accomplished. When a rod breaks and falls to the bottom of the long circular sheath, instead of trying to seize it by groping as formerly with pincers, more scientific means are used. Wax applied on a disk takes an impression of the "accident," so as to show the form and position of the obstacle to be overcome, and to indicate the means of operating with certainty. For this purpose there are various instruments of repair of very uncommon forms. One has four iron fingers converging together to pick up and withdraw a piece; another, which seizes a broken rod above the coupling with certain grip, and draws it up.

We mentioned the operation of *taraudage* (spiral screw cutting) of the celebrated Mulot. The operator smiled and replied, "It is as yet but the infancy of the art. All these arrangements astonish engineers but little, but the uninitiated find it difficult not to admire them." The great water-works of the present day have for aim to give the Parisians spring water for drinking and household purposes—a water perfectly pure, and chosen with discernment, being taken at, or very near the spot where it issues from the earth, and consequently free from all pernicious influences. After long consideration, numerous trials, and various tastings and analyzings, it was finally decided to divert the source of the Dhuis at Pargny, in the department of Aisne; and the springs, eleven in number, which form the Vanne, a river which, rising in the department of Aube, falls into the Yonne near Sens. The sources of the Dhuis and Vanne offer the indispensable condition of being at an altitude such that by an easy, natural descent, they can flow to one of the higher suburbs of Paris, when nothing more is needed than to distribute them in the city. The decrees of March 4, 1862, and October 19, 1866, which ordered the appropriation for public use of the land to be traversed by the aqueducts, caused numerous complaints to be made by persons who were—or declared themselves to be—injured thereby. Petitions were sent to the senate, but, after a public discussion, it was decided that there were no sufficient reasons for entertaining them.

The Vanne is 173 kilomètres, 83 mètres (107½ miles) from Paris; the works are partly finished, and by visiting the aqueduct of Arcueil, it will be apparent what a grand appearance it presents. The Dhuis is nearer, 130 kilomètres (80¾ miles), and is now being used, for its entry into Paris was celebrated August 15, 1865. To arrive there it traverses 104 kilomètres (64⅝ miles) of trench aqueduct; 9½ kilomètres (6$\frac{9}{16}$ miles) solid underground aqueduct, and 17 kilomètres (10½ miles) of cast-iron syphons, and enters the reservoirs of Menilmontant, which are built on the heights near Rue Haxo of sinister memory. You pass through a gate, and find yourself in a vast field, or large plateau, from whence the view embraces an extensive landscape, in the centre of which the Seine flows like a silver ribbon. No trees grow on the close grass around, but at regular distances there are heavy circular plates of glass in stone frames. These are skylights to the Dhuis, for this grassy field grows upon the reservoir and forms its roof. A rocky grotto, whose rather puerile conception does not comport with the grandeur of the work accomplished, gives access to a long gallery of masonry in which the Dhuis flows, emerging from a subterranean aqueduct. It is, indeed, a river, but comes without haste, with a sort of slow majesty, at the rate of one kilomètre (.62135 mile) per hour. It is limpid, of a grayish blue, and glides silently on the bed of inalterable cement. The gallery is large and well lighted, but it is probably the most insupportable and indiscreet gossip in the world. The moment you speak it answers, and then answers itself, seeming to mock you and imitate your voice, and should you have a cold it coughs most naturally. If several persons talk at once it imitates them all, and makes such a pandemonium that they will be glad to escape from it. Echoes seem maliciously placed in every corner, and each word is repeated to satiety, so that you are forced to be silent. On the roof plateau we have described are erected two kiosques of medium size, each of which covers a spiral stairway leading to the reservoirs.

Descending you are overwhelmed with the view of one of the most imposing spectacles which man has ever contemplated. A twilight, coming through the thick glasses above, rests on the immense sheet of water, which is entirely motionless, reflecting in reverse the pillars it ~~bathes, and the roof above.~~ This ~~reservoir~~

covers two hectaires (4.942 acres) of surface, is five mètres (16 feet, 4 inches) in depth, and contains 100,000,000 litres (26,412,500 gallons). It seems like a forest of pillars; we counted 624, which sustain a roof of 75 centimètres (29.53 feet) thick, of which 50 centimètres (19.68 feet) are of earth covered with grass plats; an excellent arrangement, which assists in preserving the water more fresh, and less subject to atmospherical variations. On this subject some conclusive experiments were made. The reservoir remained full during all the time of the investment of Paris; kept thus in case of other supply being cut off. The outside temperature, December 24, 1870, and January 5, 1871, was 11° R. below zero, (6° F. above zero); while that of the water remained between 6° and 12° R. (44° and 60° F.).

The reservoir is separated by a wall in two parts, so that during the cleansing, which is done once per year, one remains always full. It seemed that we never could sufficiently admire this colossal work, but we were not at the end of our surprise. The guide lighted a lantern, placed a candle in our hand, and having proceeded about fifty paces, on a wide shelf, which surrounds and overhangs the water, entered a stairway of masonry. After descending a few steps he stopped. "Do you know where you are?" "No." "In the reservoir of the Dhuis, through which this stairway descends; we are surrounded by water." "Where are we going, then?" "To see the Marne, which is below us!" Nothing more true. These reservoirs have two stories; in the lower is received the Marne, and in the upper the Dhuis—two lakes, one superposed. The Marne, raised at Saint Maur by hydraulic pumps, moved by eight machines placed in the old mills of Darblay, is forced into a large standpipe, whence it issues in the form of a great mushroom, and is then here conducted. These reservoirs are unique. We can, in presence of such a marvel say, without sinning through excess of pride, that we (French) are, in certain respects, not inferior to any people, ancient or modern. The two stories of the reservoirs are separated by a vaulted floor. What stones of enormous dimensions! What blocks of granite have been piled one over another to support this tremendous weight! The vaulted floor is 40 centimètres (15.75 feet) thick, and the solidity, of which it daily gives proof, is formed entirely by a series of arches springing from the pillars which support those already mentioned. The roof of the upper reservoir is of brick; all the other parts of the construction are of hewn stone, built with Vassy hydraulic cement, the composition of which is lime, silica, and alumina, with a small proportion of iron and magnesia. All is bright as polished marble, and the arrangement for cleaning is admirable. It is only needful to raise a water-gate and the Marne falls into the sewers, or the same to allow the water of the Dhuis to enter the lower reservoir. For this marvellous subterranean edifice there were erected 200,000 cubic mètres (214,000 cubic yards) of embankment, and 70,000 cubic mètres (74,900 cubic yards) of masonry. It would be necessary to understand hydraulic engineering to comprehend and properly explain the boldness of the conception, the difficulties vanquished, and the science and intelligence required for such a work. It was rapidly done, requiring only two years from beginning to completion. The cost was 3,700,000 francs, which is but a small amount in comparison with such great results.

The man who could imagine, direct, and complete such a project, may say with Horace, *Non omnis moriar.* However, this does not seem to satisfy M. Belgrand. He expects to surpass himself by the reservoirs he is planning at present at Montrouge, on the heights of Montsouris, to receive the water of the Vanne, and which will cover three hectaires (7.413 acres) of surface—one more than that of Menilmontant.*

To describe the other reservoirs of Paris after these would be puerile; suffice it to say there are sixteen great basins (*epanouissements*) where the waters are centralized and stored before taking their final course. They are all situated on elevated positions, where the aid of steam-power is often necessary to raise the water; but once arrived in these reservoirs there is no difficulty in distributing it. By a methodical arrangement of cast-iron pipes resting on the side walls of the large sewers, or running through the ground, it arrives at the precise point desired. All the water cocks in the houses and stores have screws, to which hose can be attached in case of fire, and some of the more important openings (fire-plugs) are being altered to suit the use of the steam fire-engine. Every street is penetrated, and every house can be supplied with water. These water-pipes placed continuously would stretch 1,418 kilomètres (881 miles); and, if to this be added the length of the various aqueducts, which are about 323 kilomètres (200 miles), we have the extraordinary total of 1,081 miles of conduits and pipes to supply Paris with water.† The municipality of Paris requires all who have built upon lots sold by it on the improved streets to have a water connection (concession), and this excellent arrangement should be extended to every new building. Various companies were formerly formed to distribute water to the houses of Paris; but all of them, except one, seemed to languish, and the city received back the privileges. When, by the law of June 16, 1859, the suburban districts were annexed, there was in existence a large and successful company, which had expensive hydraulic arrangements, and which served what was then called the outskirts (*banlieue*). Not being able to dispossess this company without great injustice, the municipality compromised with them, and agreements, interchanged July 11, 1860, changed the "general water company" to a sort of administrative trust arrangement. The city took possession of the establishments and of the right to sell the water, and as equivalent the company is to receive the annual sum of 1,160,000 francs, in monthly payments, and a premium of one-fourth of all excess over a revenue of 3,600,000 francs, but one-fifth part premium only of what exceeds six millions. Its duty is to attend to the subscriptions, and oversee the distribution of water in certain localities; to filter the water sold at the fountains; to give receipts for money; and to hand over all funds weekly to the proper authorities. The private concessions are rapidly increasing. In 1860 there were 21,921, and December 31, 1872, there were 37,889. The number of houses in Paris being 73,624, there are still almost half the number that must buy water from those who make a business of retailing it. These are the water-carriers, who have a hard business, but which pays well. Who does not remember them, with their bands over their shoulders and buckets in hands, crying, with a lamentable voice, "Water—er!" We are now, in a great degree, delivered from their clamors, and before long they will disappear entirely. The diminution is rapid—1253 in 1860, and at present 800, of whom 79 have tuns drawn by a horse or mule. The remaining 721 have cans strapped to the back, and carried with considerable effort. These water-carriers are not at liberty to place their tuns and cans whereever they please at night; but there are 63 places of rendezvous assigned by order of police, August 7, 1860, so that a supply may be always ready, at known places, for early use in case of fire.

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* Some enthusiasm is quite allowable to the author—Maxime Du Camp—seeing from what scarcity of water the Parisians are emerging; but several of the distributing basins of Philadelphia are much larger than the one here named, the total storage capacity being 152,000,000 gallons; and the new one now being constructed in East park covers 106 acres, and will contain 736,420,000 gallons.

† There are two separate systems of water-pipe in the streets of Paris—one to supply the impure "Fountain" water for sewer and street cleansing, fire extinguishment, &c.; the other, the "Spring" water, for household uses. This is especially suggestive for cities located between two rivers. In Philadelphia, for example, the present works and distributing pipes might remain for fire, manufacturing, and fountain uses—while a new system of pipes, together with an aqueduct, tapping the Schuylkill or the Delaware far above all impurities, and entering the vast new reservoir now being constructed, would solve the vexed question of a perfectly pure supply of water for the city.

Paris has 26 fountains, called "marchandes," merchant or retail fountains, at which the carriers fill their cans; a post, and a large copper tube with spigot, being all the apparatus required. The water sold from these fountains comes directly from the city reservoirs, but is filtered before being delivered to these water merchants—"Auvergnats," as they are called indiscriminately, regardless of province. The water traverses two receptacles, from whence it cannot emerge without passing the meshes of a screen furnished with sponges, gravel, and loose wool.* As all the tuns and cans are gauged at the office of the chief of police, and the contents placed in large figures on the posterior front, there is never any discussion about contents. Those holding 1,000 litres (264 gallons) pay one franc, and are retailed for five francs by the carrier. Four hundred per cent.; is it too much? No. When you consider the numerous trips the poor fellows are obliged to make up dark or dangerous stairways, steadying themselves and two pailfuls of water, by aid of the balustrade, you will not think their gain is excessive. The water-carriers are not forced to use the "merchant fountains," but have also the right to draw from twenty-eight others, called "band fountains," because it is forbidden to approach them with cans, and only buckets, which are carried by a band passed over the shoulders, can be filled therefrom. An iron hook is on each handle, and the buckets are kept from the person by a hoop, and have wooden covers to prevent the contents wasting. This water arrives from the reservoirs and conduits just as it entered them, and is charged with earthy salts; is grayish, muddy, and not very enticing to the taste. It is now scarcely used at all, and the two fountains formerly most frequented—that of the Rue Saint Honoré, and the Rue de Grenelle—are at present almost deserted.

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* The filterer of the Longchamps's basin at Paris has: Fine sand, .30 mètres = 11.81 inches; medium sand, .08 mètres = 3.15 inches; coarser sand, .18 mètres = 7.08 inches; fine gravel, .12 mètres = 4.72 inches. About an inch of the upper layer of sand will hold most of the impurities, and to cleanse the filter it is only necessary to remove this.

The law of 1852 requires that all water furnished to London shall be filtered, but a portion only is thus treated, some companies paying no attention to the requirement. The filtering bed of the Chelsea reservoir is as follows: Fine and coarse sand, 4 feet; pieces of slate, 6 inches; fine and coarse gravel, 1 foot 6 inches.

The concessions and the "merchant fountains" are a source of large revenue, which must certainly increase in the future. At the commencement of this century the value of the water sold yearly amounted to 385 francs; for the year 1872 it was 6,111,295 francs. Besides the water furnished by the city, there are in Paris about 30,000 wells, which, however, are not much used. During the siege, as it was feared there would be a short supply of water, about 20,000 were put in good repair. Placed in close proximity to wells of a different character, the water is generally bad, and often quite impure; yet formerly they were much used, and in some localities were the only resource.

The "merchant fountains" and the carriers will all soon go to rejoin the old wells, and our children, accustomed to water in the upper stories of the highest houses in Paris, will be astonished that we preserved so long the primitive means of overcoming one of the greatest necessities. There is much more water used than is paid for, but this is not closely examined, and wisely so; yet the proportion is considerably more than the water-merchants call good measure. The concessions for the water of the Ourcq, for example, pay for 36,822 cubic mètres (13,366,386 gallons) daily; but, as there is no restriction, 70,000,000 litres are used per day (18,488,750 gallons). If the use of meters were possible and regular, the city revenue would be greatly augmented.

Whilst awaiting that the Vanne shall bring an increase of 100,000,000 litres, (26,412,500 gallons), there is used in Paris daily a volume of water varying from 150 litres, the maximum, to an average of 74 litres to each person, in a population of 1,851,792, as found by the census of 1872 (averaging about 25 gallons per head). This is a great quantity if we compare it with the supply one hundred years ago; it is sufficient, if we view only the indispensable exigencies of private and city life; it is small, if we reflect that water is a means of health, and cannot be too abundantly used in large cities; but it becomes almost ridiculous if we refer to certain ancient supplies. In the reign of Nerva, Rome had 1,000,000 inhabitants, and received daily 800,000 to 900,000 cubic mètres, (about 224,000,000 gallons), or 800 litres (211 gallons) per head—nearly ten times our present average. But we do not intend to rest where we are; the embellishment of Paris and the public health require and demand an abundance of water.

A day will come when there will be no economy used, but water will flow constantly as from an inexhaustible source. On the 10th of April, 1803, Napoleon wrote: "It is shameful that water should be sold from the fountains of Paris. What I desire to see is, that the fifty present fountains shall flow day and night from the 1st of May proximo; that the sale of water shall cease, and every one take as much as he desires." This was a just view, and although since the emperor used these words to his minister Crétet, Paris has tripled her population and overflowed her old limits, it is to be hoped that in a future, more or less near, the capitol of France will have as much water at her disposal as Rome had in the days of the Cæsars.

SOCIAL RIGHTS AND DUTIES.

IT is not so much the political as the social problems, says Schultze Delitzsch, which (and in a far higher degree than it appears to a superficial observer) agitate the minds of the present generation. However much the struggle for political and national development claims the interest of nations, yet more and more consciously the human element, the human right to life, appears both as the source from which political activity issues and the goal to which it tends, since political institutions are subservient to this element only as a means to its end. For this reason the aspirations of our time are no longer confined to the State, as a mere form, but are more directed towards its abiding substance, human society, as towards the foundation of all human existence and prosperity, laid by nature itself. And here our entire consideration is claimed by the natural rights and duties arising from our social position, aside from the compulsory demands on the part of the State; for, indeed, with them the most important problems and questions of our time are connected, which have an equally important bearing both upon the material and intellectual interests of life.

In discussing the social rights and duties here referred to, we must therefore examine the nature and purpose of human society, in order to determine what such society is and is to be for man; and this immediately turns our attention to the nature and destiny of the men who constitute it. Only thus is it possible to determine the normal relation between the individual and the totality as the infallible measure for the right of our social conditions to existence; only thus we gain the necessary presuppositions in order to approach the evils which here meet our eye, and to attain to a mutual understanding regarding their causes, as well as the means for removing them.

In beginning, therefore, with man as an individual in his relations to himself, we start from some well known theses in order to draw our conclusions from them. As an organic being he appears to us as subject to certain unalterable laws of nature, which form the conditions either of all life in general or of his own in particular. Thus his existence depends upon the undisturbed process of certain vital functions which he has, for the most part, in common with the whole animal world. But what distinguishes him from all other beings on our globe is his personality—*i. e.*, his self-consciousness and self-determination; for these properties assign to man a position towards those laws of nature upon which his existence depends, that is entirely different from that of all other beings. While they enable him to discover these laws as the abiding, eternal agency underlying the varying surface of phenomena, and to make them the rule for his actions, we find, on the contrary, that in animals and plants these laws prevail directly and unconsciously, without any knowledge or will, in the true sense of these words, on the part of these beings. In the compulsion of instinct the animal finds what is adapted to its nature, and avoids what is hostile to it; while it is man's duty to appropriate the necessary knowledge in these things, and it depends on his resolution how far he will be guided in his actions by such knowledge. And this constitutes both his strength and his weakness. The animal, given up to the current of natural necessity, can neither err nor commit a fault; man is liable to both. In his knowledge of the laws of his being, and his corresponding position towards the outer world, which are to determine his actions, error is possible; and by virtue of his free will he can, even by his actions, do a wrong against his knowledge of what is right. This cannot be otherwise: without the possibility of error there is no knowledge—no freedom without the possibility of doing wrong. If truth were enforced upon everyone from the beginning, we never could speak of seeking and findng it—*i. e.*, of appropriating it by our own activity from free choice—and this is what constitutes knowledge. It is similar with our actions. If we had no choice—if we always had immediately to seize upon the one thing which is right, this would exclude all traces of freedom and place us under the ban of animal instinct.

But no one will understand the possibility of misconceiving the laws of our being, and of acting contrary to them in such a way as if it were in our power to throw off our obedience to them. On the contrary, they connect with man's actions and omissions certain absolute consequences which he is unable ever to alter. As by a correct knowledge, and a course of action adapted to it, we are furthered in attaining to the ends of our existence, so in the other case obstruction and disturbance in our existence, or in other words, evil is unavoidably attached to our steps. Thus, to illustrate by the most familiar example, our existence depends upon the law of the circulation of matter—the constant consumption and replacement which every minute builds up anew our organism. We must eat, drink, breathe, etc., in order to live. By virtue of his free will, man, to be sure, may abstain from food or respiration, and *kill* himself by hunger or suffocation; but by no means can he *live* without respiration or food. By abstaining from either he acts against a law of his existence; but by this very act he destroys the latter, and the law prevails at all events.

According to all this, we behold in self-consciousness and self-determination the climax of human nature. From the impulse towards truth and towards freedom flows all thinking and acting worthy of man. To recognize that which is good and beautiful, right and true, and to realize that which has been recognized as such in all practical relations of life into which they enter, is the desire of all who are animated by a spark of spiritual aspirations. And as the striving after truth could never attain its end without corresponding freedom, so freedom without knowledge would lead to self-destruction. Therefore both presuppose one another, form each other's necessary condition, and in their perfect, mutual penetration, in self-conscious will—*i. e.*, in the knowledge of the laws of our being and of nature surrounding us—and in corresponding action derived from free resolution and conscious of the consequences, lies the aim of individual development.

Having thus considered man as an individual, we proceed now to the mutual relations which connect him with his equals. In this respect he appears to us as a social being, compelled by his natural qualification to live in common with his equals. He cannot, like the game in the forest or the carnivorous animals in the desert, exist in isolation, without the company of others of his kind, unless he would pine away. In such complete solitude he would miss his destiny. We must, however, separate this idea from all theological secondary thought. We consider as the natural destiny of all organic beings, including man, the complete development of all germs and faculties with which they are endowed.

But to such a development individual man never attains in complete seclusion; he rather requires, as a necessary condition for it, the company of his fellow-beings and the exchange of mutual aid with them which depends upon it. Without this the individual would, in most cases, be unable to secure hardly the most stunted physical existence. And should any individual, under especially favorable circumstances, really for once succeed in this, yet the whole energy and activity of such a one would be exclusively consumed by providing for the most necessary means of subsistence, without his retaining any time and opportunity for cultivating his higher faculties. Let us well bear in mind that even the saddest lot imaginable within human society is at all events preferable to an existence outside of it; for, such an unfortunate, thrown upon himself in solitary seclusion, would miss everything which makes existence endurable even to the poorest being among us, not excepting language and logical thought! Such conditions, however, are entirely beyond our experience, for in reality there is no man in such complete seclusion—the best proof that such a condition is contrary to human nature.

The social intercourse of men is therefore no invention of their own, nothing they have introduced at pleasure, or for greater convenience, which might just as easily be dispensed with; but rather the direct efflux of their own being, a natural necessity. So long as there have been men in existence, and wherever there may be men, there too is society. Seclusion for them would be equivalent to death; their natural condition is the social condition. The impulse for society, which, indeed, partially coincides with that for self-preservation, is one of the strongest of our nature, and the organization of individuals resulting therefrom, society, as being dependent upon our own organization, is itself again a natural product. But, as such, it is just as much subject to definite organic laws which control the process of its formation as the individuals constituting it, and as in general all natural existence. To ascertain these laws it is necessary, above all things, to gain a clear insight into the nature of society, in which respect it may be expedient to refer in general to a two-fold point of view. In the first place, we see man on account of his individual development, and for the sake of attaining the aims of his individual existence, directed to society, which thereby is determined in one direction. According to this, it consists of a multitude of individuals, each of which pursues his separate aim by the side of the other, while at the same time it is equally subservient to all as the necessary means for attaining their ends. This is the legal side of society, according to which the individuals constituting it have in common only the means, but not the ends, with the maxim controlling the whole legal sphere, which assumes the form of a prohibition rather than a command—not to do to any other what we do not wish him to do unto us—a side which we have principally to vindicate for the State.

But then we see on closer observation, besides the furtherance of individuals in their separate aims, another panoramic picture rising before us, which opens a higher point of view to us. As a self-conscious being man is able to give permanent expression to his existence and actions in an abiding result, to fix his thoughts and actions, by impressing the objects of the outer world with the traces of his action, and lastingly transforming them for his own purposes. Thus the individual attains to a significance reaching far beyond the boundaries of his own existence, which secures to him an influence not only upon others living by his side, but even upon future generations. By virtue of the characteristic of communicability or transferability resulting herefrom, which attaches to the fruits of our thinking and acting, these become the common property of entire epochs, are transferred upon future generations, and accumulate from century to century like a grand inheritance of the human race upon which the descendants enter at their very birth. In direct contrast to the animals which even now occupy the same standpoint as the first of their kind in gray antiquity, men born in aftertimes are thus spared all the troublesome beginnings which exhausted the whole strength of their ancestors in different branches of human knowledge and activity. By commencing themselves where the latter left off, they must necessarily carry their work further, an unbounded, vast growth from generation to generation. What a great difference is there between the best and wisest among nations of antiquity, with their crude and perverse conceptions of the nature of things, and any of our children, even when only moderately well educated—to whom, for example, the explanation of the most important phenomena is imparted as something self-evident during their school life. And, again, what a vast difference is there between the accomplishments of those earliest inhabitants of our globe, who had to wrest by toil the necessaries for the support of their lives from the earth, without hardly any tools and other aids but their physical strength, and the progress of modern industry, which, with its ingenious machines, leaves the so-called wonders of antiquity far behind in availing itself of the powers of nature! All this the present generation receives as an inheritance belonging to it by right, and finds in it only an impetus on their part to accumulate new treasures in addition, in order, thus enlarged and enriched, to transfer it again to their descendants. Thus we see not only those individuals who exist simultaneously, but even those succeeding each other in time, most intimately connected, gaining in a certain sense a continuity, a uniform connection of life. And thus is unrolled before our eyes the picture of humanity as a whole—as that of a collective being, whose existence goes on uninterruptedly in an incessant coming and disappearing of generations, as the life of individuals amid the change of atoms. Thus we reach the conception of the destiny and ends of humanity in its totality, which, to be sure, necessarily involve those of all individuals, but which also in the same manner remain superior to them, as the species is superior to the individual. Only in humanity as a species the idea of man attains to its complete realization; it alone endures by combining the total existence and activity of all individuals constituting it, in the continuity of time and space. Therefore it is this very life of humanity as a species, with its inheritance increasing from generation to generation, and forming the only source of all progress of civilization, and the gradual perfection of human, intellectual, moral, and economical conditions, to which alone we are indebted for the possibility of a history of mankind. Its form is society.

This observation leads us to its other side. From a mere commonness in the means which we found it to be from the first point of view, we see it rising to a commonness in the ends; *i. e.*, changing its purely legal character to a moral one. And as such it addresses to the individuals which it embraces in common action for the same end, instead of the merely negative admonition to abstain from all disturbance and violation of their fellow-men, the positive command to give them their brotherly assistance, and do everything in their power to further them in attaining the purposes of their lives, since these in the end coincide with its own existence. Thus we see here, as everywhere in nature, means and end, cause and effect mutually interlace each other as the links of a continuous chain. The individual is in need of society to attain his separate aims, and all individuals in their totality are, consciously or unconsciously, subservient to society as to the form of their common life for attaining the higher ends of the whole race.

Having, then, started in our disquisition from the fact that the individuals who constitute the collective being of society are beings created for social life, and that therefore the laws of their individual human lives cannot be contrary to the laws of society, but must coincide with them, we found all individuals endowed with self-consciousness and self-determination. By virtue of the former faculty they are able to become conscious not only of their individual vital processes, but also of the life of the species whose exponents they are, of their social relations, of their position as members of a whole. By virtue of the second faculty the play of their will may exert sometimes a furthering, sometimes an obstructive interference, but always at their risk, since the consequences of the natural laws affected by them are inexorably attached to their actions. But from this mutual influence between individual and total existence, by virtue of which each is indispensable to the other for its support, follows the necessary conclusion that the individual, in pursuing his separate aims, must never violate the fundamental conditions of society in general; while, on the other hand, society must not only not place any obstruction to the fundamental conditions of individual development in each individual, but is in duty bound to further it in any possible manner. Only in guaranteeing the possibility of individual development and self-assertion in life to all, society secures the guarantee for its own prosperous existence.

If we thus far have indicated the highest aims and ends after which humanity aspires in the course of centuries, it is self-evident and confirmed, even by the most superficial observation, that reality remains far behind them; for this process of rising civilization is an historical process, during which our race gradually approaches these ends. But, however long a distance may still separate us from them, yet a great part of the way lies already behind us, the most difficult beginnings are overcome, and the consciousness thereof is fully awakened in the minds of mankind. Everywhere we see nations struggling against hostile powers which oppose the progress of civilization; everywhere we behold them seriously engaged in perfecting their social institutions and improving their conditions. In doing so they are of course exposed to deprivations and sufferings of all kinds, which are inseparable from such intermediate stages of development, from the struggling attempt to exchange the imperfect for the perfect. And this leads us to the place assigned to evil in the human world.

We have already traced evil, the obstruction and disturbance of human existence, with all its sad consequences of mental and physical confusion, of moral and economical ruin, to human imperfection as to its first origin. We saw man, by virtue of his self-consciousness, enabled to gain a knowledge of the conditions of his existence; by virtue of his self-determination it was in his power to adapt his actions to them. Error in knowledge and actions, even against better knowledge with all subsequent evils, will therefore be so much the more in order, the more backward is the intellect and moral development of individuals as well as of whole nations; for, as we already intimated, both commence their career in ignorance and barbarousness, and long toil and persevering effort are required to strengthen knowledge and will to such an extent as to find, after many devious aberrations, at last what is true and right, and to follow it as the standard of action and of omission. This cause of evil at the same time involves its necessity. By making its appearance as the inevitable consequence of the violation of our vital laws, it teaches us how to recognize the wrong ways and to find the right path; while, on the other hand, at the same time compelling the slumbering power of our will to energetic defence. Evil is therefore both the consequence of freedom and at the same time its corrective, and inseparable from it by its very nature. To remove evil from the human world would be equivalent either to the abolition of freedom or to a sanctioning of its misuse. But both could be thought of only if law were removed from nature, no matter whether an ideal condition can be imagined, when mankind, at the end of their development, will be "delivered from evil": we consider the struggle with evil as the task of human life, as the substance of all history. Only this can therefore be asserted: that evil has an inherent tendency of limiting itself by its own consequences, and that rising civilization alone opens the prospect for its gradual abolition.

But, however simple these statements appear in themselves, we yet meet in life manifold complications and contradictions regarding them, since we do not unfrequently see evil make its appearance where no guilt, at least of those who suffer from it, is traceable; and this contributes not a little towards shaking the conception of its justness and salutariness. We cannot refrain from a somewhat closer inquiry into this relation.

In the first place we meet a whole chain of such influences upon the fate and success of men, the control of which is more or less beyond their power, in the power of nature, upon which our welfare and our enterprises to so great an extent are depending. Without entering into any details in this direction, and in any way contesting this dependence, we would only call to mind that this dependence decreases in the same degree in which men's insight into the laws of nature and their corresponding use of the powers of nature increases. Although, therefore, we may not make the individuals and their defective individual development responsible for their powerlessness in avoiding the evil produced by hostile powers of nature, yet we shall have to acknowledge them in general as a consequence of a defect in the knowledge of the whole race, and therefore in the total development of humanity, to overcome which the very evils resulting therefrom constantly impel our race.

To the same point of view we have to adhere at another series of influences, which make themselves felt in a similar manner, and immediately touch upon the principal subject of our discussion. These are the social institutions and conditions of a political, ecclesiastical, and economical nature, which in different communities exert an essential influence upon the condition and development of the life of their members. In so far as those concerned in them have no voice in shaping them, since they rather enter upon them at their very birth without any coöperation of their own, we obtain, with regard to the evil resulting, a similar causal connection as with regard to that caused by the power of nature. In both cases it appears to be undeserved as regards the individuals suffering from it, while we have to seek its source in defects of the general state of civilization, as the effluxes of which those institutions have to be considered. But, on the other hand, the comportment of the sufferers is in both cases very different. If men in general yield to the superior power of nature as to a higher fate which no one can alter or take to account, they consider, on the contrary, in defective social institutions a mere statute of man, which bears so much the more the character of arbitrariness the more the sufferers themselves are excluded from their management and further development. And because thus in society the ruling classes favored by it are regarded as the antagonistic exponents of personal responsibility, the standard of right and wrong is applied, and the former are so long burdened with the blame for such oppressive institutions as they profit by them.

It is certain, from what we have established regarding the nature of society, that it can in no way decline the insinuated responsibility for its institutions; for we have indeed conceived it as a living organism of the totality in which the aggregate knowledge and aspirations of an epoch are personified. And as such a collective being it is just as subject to certain laws corresponding to its nature, and in consequence of their violation just as inevitably exposed to disturbances and evils of all kinds as the individuals who constitute it. It was above all the mutual relations between it, as a totality, and these individuals, by virtue of which none can do without the other for its existence, from which we derived the supreme one of these laws—that neither part is to violate the conditions of the other's existence, and that, in particular, society has in every possible manner to further individual development as the end of individual life. By this supreme axiom the mutual rights and duties are determined which social intercourse imposes, inasmuch as they find their expression in two opposite postulates which naturally limit each other—that of freedom and responsibility.

If among the obligations of society the guaranty of personal liberty for all its members stands foremost, as the element of all development, in which alone the prosperous development of human nature, in accordance with individual faculty and choice, can be imagined, this freedom is, on the other hand, necessarily limited by each individual's duty—by his comportment not to encroach too much upon the foundation of society. Thus to personal freedom the responsibility for its use is added as the keystone of the social structure. If the individual claims free movement for himself, and guarantees for it by society—*i. e.*, by all the others—he must respect such freedom in all these others, and must not disturbingly invade the legal sphere of any of those who are entitled to an equal guaranty. Against any such outrage society has to protect each one of its members, and for this purpose it constitutes itself into a State society, thus creating the necessary executive. Only universal security is the guaranty of freedom for all, as that condition which offers to each one the possibility of an undisturbed use of his powers in pursuing his self-chosen aims within the specified limits.

At the same time one thing ought not to be lost sight of. The postulate of the universality of this condition likewise involves that of equality. To the actual readiness of protection for and extension upon *all*, the equal measure of protected rights, the uniformity of this protection for *all* must correspond; in a word, *the equality of all before the law.* The admission of privileges to some is possible only at the expense of the rights of others; an unequal distribution of rights and duties can affect the privilege of one part only to the disadvantage of the other, but it never leads to a condition which can be called common to all. Rather does the commonness of legal life, as the guaranty of the freedom of all on the part of the State, attain to its completion only in the equality of the rights of all. From this no allowance can ever be made in deducing social rights and social duties from man's nature; for, indeed, nature has assigned to all men an equal destiny, the same equal conditions of life, and thus herself granted to all the right to claim an equal possibility to satisfy them in equal development. Any institutions, therefore—be they political, ecclesiastical, or economical—which in derogation of this principle prejudice any individual or whole classes of society in favor of others in these equal conditions of development, and thereby throw any obstruction in the way of their attaining to their purposes of life, are to be entirely rejected. And this so much the more emphatically, the more they lead to subjecting one part of the population to the complete enslavement and exploitation by some other part. A society which sanctions any such thing exercises itself against what it is in duty bound to protect all its members, against a part of them, puts itself thus in contradiction with its own purpose, and forfeits the right to existence. And how sad consequences afflict such a commonwealth as a penalty for the violation of the social laws of nature! Not to speak of the bloody rebellion of the oppressed, of civil war and its horrid accompaniments, what a fearful burden does society impose upon itself! what germs of destruction does it foster in its own lap! Is not all vigorous aspiration suppressed in the suffering classes when they find themselves in every way obstructed in the freedom of their movement, and to a great part deprived of the fruits of their activity? Must not, at such encroachments upon their self-determination, all moral and economical impulses be paralyzed in them, their capacity for work, their good will, be reduced to the lowest level? And more than this! Not enough that thus a great many faculties are lost for the purposes of society, in its own midst a hostile power arises, which, growing with oppression, opposes crime to wrong, and puts itself on a warlike footing with society. But, since for the repression of such crime again a part of society's available faculties must be employed, the balance-sheet of its account, with profit and loss, becomes more and more unfavorable, and in an antagonism of classes which becomes more and more hostile, the sense of the solidarity and commonness of interests is more and more lost, and with it the vital nerve of every community.

If the destruction and dissolution of the social bond of union which is thus brought on, already in itself strikes the favored classes the hardest, because they derived the greatest advantage from it, the guilt which in such a development of things is laid to their blame is quite especially vindicated in their own persons. Man has indeed the power of influencing by his actions, be they good or bad, his fellow-men in wider spheres of life, of involving others in their consequences—but he can never himself escape these consequences. If, therefore, any individuals or whole classes, by an abuse of their power, suppress others in their social existence for their own selfish ends, and if they alone apparently derive all advantage therefrom, leaving to the others all disadvantage, yet in the end they reap themselves the fruits of such conduct. They, too, are inevitably reached by the evil; if not immediately in an external, tangible shape, yet in the inner core of their own lives, whence it undermines in steadily growing corruption their whole existence. History proves this everywhere, where such ruling minorities succeeded in throwing off any efforts for external subsistence, all burdens of life, and to impose them upon others—thus living at their expense. Such conduct, in the end, always turns against the oppressors. Soon inordinate sensuality overcomes by its rank growth all active energies, and the habit of making others subservient to their selfish ends suffocates the moral sense in themselves. The excess of enjoyments stunts body and mind, and in the midst of abundant means for enjoyment their capacity for it languishes and induces them to turn to unnatural incentives. The deepest demoralization creeps into all relations of life, until at last they sink into that pool of mental perversion and moral corruption which appears as the forerunner of threatening ruin, from the downfall of the ancient despotisms and the destruction of the Roman world, to the latest catastrophe which engulfed the American slaveholders in its ruin.

The natural necessity of this historical process becomes immediately evident if we bear in mind the axiom established before—that the laws of society everywhere reflect upon the laws of individual life. Mistaken social duties always involve a trespassing against the natural conditions of life of the individuals, and *vice versa;* and here it is again and again individual development which above all claims our consideration. As on the one hand the physical and mental faculties innate with us are developed and preserved efficient only by exercise and use, so, on the other hand, since this always results in their consumption, likewise their reproduction, their ever-renewed accumulation is necessary, if their fund is not to be exhausted. Therefore an alternation between labor and repose, toil and enjoyment, is indispensable for our physical and mental prosperity. The right proportion between the consumption and reproduction of power constitutes a normal existence; while, on the other hand, the disturbed equilibrium between both always produces fatal consequences for the physical and mental economy of the whole man in one or the other direction. And thus the two extremes in the earthly lot of men coincide in their final effects. An incessant, exhaustive wrestling for the necessaries of life; a restless grappling with its tasks without a sufficiency of means for it; an ever-imposed pressure without the possibility of shaking it off, lead to a condition of pining away. An existence of mere enjoyment, in luxuriant repose, without any higher aims and aspirations, without trouble and labor—a comfortable abandon without any energetic effort of will and power—leads to degeneration. The result in both cases is a caricature of human nature—one in its saddest, the other in its most disgusting shape; in both cases the nobler part of our nature is killed, the true destiny of man missed! This is the act of justice by which nature punishes social exploitation as a rebellion against her eternal laws.

But not only unjust encroachments upon personal freedom, not only the withholding of the equality of rights, the external pressure upon the economical condition, and whatever is connected with it, touch upon the individual right to life, and prevent the individuals from becoming for themselves and society what they are to be according to their natural destiny. In our time, where the crudest forms of external violence and despotism among the civilized nations have more and more disappeared, another element produces rather far more fatal effects. This is the neglect of human culture, the deficient care for developing the innate faculties of the individual, which, as an indirect consequence of the oppressed social position, opposes every permanent rising. Whether anyone's development is violently kept down at any stage, and the use of his faculties made impossible for him by external pressure, or whether he is in a condition where these faculties do not at all attain to their development, has the same effect. Most fatally, of course, this danger of being stunted threatens that period of life in which the individuals have not the power of contending against it for themselves, but are entirely dependent upon the aid which is rendered to them by others, viz., the period of childhood. Since regarding this matter, especially as far as the obligations of society, the mutual relations of family and State are concerned, very confused conceptions are still in vogue, so that it has even been attempted to contest these duties in behalf of freedom, a special disquisition on this matter will be in place here.

More than any of the beings that inhabit our globe, man is, during a long, helpless childhood, dependent upon the good will and care of others. With no other being are prosperity and ruin to such a degree depending upon the care shown to him in this respect, and none is, in consequence, capable both of so extraordinary a development for good as well as for bad, and of so salutary a use as well as of so fearful abuse of his faculties. The absence or a perverse direction of this care therefore injure, in the same measure as we perceived this with regard to the pressure upon the external condition of life, not only the sufferer, but at the same time the totality upon which they impose in him a burden instead of a useful member, for which reason the former has not only as great an interest as at the abolition of objectionable political institutions, but also the urgent duty to interfere with its aid. Care for childhood, instruction and education of youth, as the presupposition under which alone society can prosperously be developed, must therefore be guaranteed by it in their most indispensable foundation to all, just as much as personal freedom and security. Although the family may in the first place be entrusted with these duties, yet the interference against manifest neglect, compulsory school-education, the limitation of domestic discipline, must be turned over to the State and regulated by its laws. Legal compulsion in these matters is no deprivation of freedom, but rather furthers its most essential elements, without the care and protection of which man never attains to maturity for it. No one, as we agreed, can be allowed to carry the exercise of his freedom so far as to disturbingly encroach upon the life-sphere of others. To provide protection against such encroachments is, as we have seen, the duty of the State. As the latter has accordingly to secure everyone against attacks upon person and property, violence and murder, so also against the stunting of his mental faculties, the suffocation of the germs of higher life before their development during helpless childhood, in so far as a palpable neglect on the part of those is manifest whose duty it is to educate their own children. As a father is not suffered to starve his child, or to do violence to his life and health, so childhood and youth must likewise be protected against moral and intellectual neglect as against a worse murder —the murder of the mind. In youth, as its rising after-growth, society fosters its own future. Let it see to it—we repeat our warning—lest a part of this youth, by thus stunting their human development, be urged into paths which threaten the social order with the greatest dangers.

According to all this, no one will be blind to the deep significance of the conditions under discussion for private as well as public welfare. But for this very reason the interference of State authority is in many cases far from sufficient, since the latter, from its nature, is better able to assert itself by preventing excesses and by establishing certain general measures, than to sufficiently satisfy the positive needs in detail. Here, rather, is the point where we must rise from the merely *legal* to the *moral* standpoint of society. For this purpose all are to unite their efforts whose consciousness is sufficiently cultivated to conceive that higher civilized community of our race, to fill by their own activity the gaps left open by the State. The sense of the existing great evils is deep-rooted in those who suffer from it, in our laboring classes, and the earnest and lasting efforts which they make, despite of their unfavorable condition, to rise to higher culture and civilization, cannot be too highly appreciated. Wherever they have met with encouragement and aid, the best fruits are already perceptible, and the path is opened to further, unbounded progress, leading the masses more and more to mental and material independence, and thereby aiding them in beneficial cooperation in the great problem of our century. And as what every one of us is doing in this direction is for the benefit of all, so also in quite a special sense for his own individual benefit; for it is the only way to permanently establish that degree of prosperity and thrift in which every one moves with his family. Let all bear it in mind—not by exclusiveness, not as an exception, does the prosperous condition of individuals secure in our time the guaranty of unendangered continuity, but solely by our endeavoring to make such prosperity accessible to all, to open for all the way to the possibility of rising to it, as far as possible.

May these general outlines be sufficient for the present purpose of our discussion of social rights and duties. It was above all our aim to prove that the moral law which controls the higher stages of society, although lacking the external support of State authority, yet by no means falls exclusively within the sphere of so-called good will. It rather has its executive power within ourselves, in our *conscience*—*i. e.*, in the consciousness of its natural necessity, as a principal part of our own being, the violation of which, as that of a fundamental law of human existence, involves injury and destruction of this existence with the individual as well as the whole. For this very reason its postulates coincide, as we have seen, with the well-understood interest of every single one of us. This, especially, we cannot lay too near the heart of the more favored classes, since they, above all, should find in their culture and secured position of life an incentive for coöperating in all such efforts. It is not true if humanity is represented as something superfluous, not quite reconcilable with our interest. On the contrary, there is no greater prudence than humanity, no more useful investment of faculties and means, none that bears a higher interest than that expended upon efforts of this kind. Aside from the material reasons adduced in its favor, already man's own personal development is in the highest sense dependent upon it. Without manifesting his moral power by embracing the cause he has recognized as good and right, there is a gap in his nature which is filled as little by dead knowledge as by material possessions. Only the active interchange of thought and action, of duty and will, gives to the individual the full realizing enjoyment of existence; from it alone flows true inner gratification. And the weight of this observation is still immensely increased if we turn our attention to the mutual relation between ourselves and society. What actions of the individuals thus truly inure to the benefit of society, return to themselves with doubled blessings. However much one may give, what he received for it beforehand from society and is still hourly receiving in return, far outweighs it. Only from the aggregate life of all contemporaries can the individual's life prosperously work its way upwards; from it it gushes-forth steadily, to flow back to it and to intensify it.

To feed our mind upon the treasures of civilization, to enlarge our breast for the common sense of our humanity, to participate with heart and head in the aspirations which imprint the historical character upon an epoch, and constitute as it were its spiritual vital air—that alone is life, is rising to man's full destiny; the opposite is dying unto all higher interests—spiritual death.

Would that this conception might more and more penetrate the spheres of the prosperous and educated! However much or little the individual may accomplish for those high aims; however humbly everyone realizes the insufficiency of his individual strength in comparison with the greatness of his task; with united strength much can be done. Already does the more and more vigorously growing life of associations, the hopeful characteristic of our time, put forth its promising blossoms in this direction. In such associations, which are formed according to the equality of sentiment and aspiration, the society of our days takes its irresistible initiative, and is organized for free coöperation as a moral power, in order to bring the higher problems of civilization, the great questions of the time, which touch upon those spheres of human nature that lie beyond the sphere of law with its merely external means of power, nearer their future solution.

THE NARROW GAUGE AND HOW IT WORKS.

IT is related of a Frenchman whose capacity of stomach was great, but his digestion poor, that he was obliged at times to diet for the gout, and once while doing this found himself at a public dinner table opposite a sturdy farmer, who, bewildered by the array of unpronounceable things on his bill of fare, could detect but one dish suited to his taste, and so ordered "pork and greens." When his plate was cleared and the waiter came to change it, the farmer again glanced down the mysterious bill of fare, hesitated, and finally, to the astonishment of his *vis-à-vis*, ordered more "pork and greens." For the third time the waiter came for his empty plate, and for the third time the bucolic guest ran his eye down the bill of fare, and dazzled by the variety and the French, again ordered "pork and greens," adding, "I don't know anything about your new-fangled dishes, but I *du* know pork and greens." The poor gormand opposite threw up his hands in horror and cried, "*Mon Dieu!* such an appetite wasted on pork and greens!" Somewhat like this *bon vivant* stands the scientific gormand of the day, able to swallow, but not to digest, all the new-fangled theories, and regarding with pity the practical man who always prefers the old to the new, even though the way be plain and tempting before him, and who can sit down daily to a feast of inviting theories, and yet in all his scientific researches never get beyond "pork and greens." There are, however, many such men now-a-days. Generally speaking, it is safe to go no farther than one can see. We can to this extent commend the farmer, whose appetite never got beyond his common sense, and whose best argument for his faith was that he didn't know anything about the new-fangled dishes, but *did* know "pork and greens." He was honest so far as he went, and differed in a marked degree from that numerous class of scientists who, themselves narrowed to a single hobby, condemn the rest of mankind if they don't follow in the same rut.

The introduction of any new system has always been fraught with heated discussion, and since the days of Copernicus more than one man has been threatened with hanging for declaring less important truths than that the earth is round. Perhaps no branch of science has engendered more discussion, bred more theorists, and blasted the reputations of more scholars, than the application of steam to locomotion. Men will cling to theories and be blind to facts. The story of the English engineer who stood up before a London audience and gravely and learnedly argued that steam could not be used in sea-going vessels, then at that moment an ocean steamer was riding at anchor in the harbor of Liverpool, is only an amusing instance of the persistency with which men will follow mere fancies and forget to watch facts. There are those who have said, and still say, that narrow gauge railways cannot be successfully operated. The attempt in this country was fraught on all sides with predictions of failure. Wise engineers shook their heads, and the masters of science were in doubt. There were discussions and speculations on every hand. The journals have been full of it. Arguments pro and con have been promulgated; and the most marked feature of railway literature in this country, the past year or two, has been the war of gauges. As a theory the new system has had its earnest adherents and its persistent foes. It is now time to decide. We are beginning to know what it is and what it does. Whether the system violates known rules of science is not a matter that concerns the mass of men; it is to be judged by its practical workings. If there has been a bias either way it has always been in favor of the broad gauge. We remember, only a few years back, when the six-foot gauge seemed likely to obtain the greatest popularity. Three great lines were constructed connecting St. Louis, Cleveland, Buffalo, and Cincinnati with New York. Subsequently all the railways of Missouri and many of those in the South adopted a five-foot gauge. Within five or six years, however, many of these have changed their track, and the four feet eight and a half is almost the prevailing gauge. There seems to have been a gradual narrowing up. The question now, however, is not whether the three-foot gauge will do the work of, or in any way supplant, the present standard gauge, but whether it in itself is a success, and likely to be a permament and growing feature of our railway history. It is now scarcely two years since the first narrow gauge railway was put into operation in this country. The Denver and Rio Grande may be claimed as the pioneer line, and as it also is much the longest line, will best serve our purpose in showing up the practical workings of the system. It will be well to note, however, how, without awaiting results, the success of the scheme has been anticipated, for there are now in operation in this country the following railways of three-foot gauge:—

State or Territory.	*Roads in operation.*	*Miles.*
Alabama	Tuskegee	5½
Arkansas	Arkansas Central	57
Colorado	Colorado "	26
"	Denver and Rio-Grande	156
Georgia	North and South	20
Illinois	Cairo and St. Louis	56
Iowa	Iowa Eastern	20
Kansas	Leavenworth and Denver	56
Kentucky	Louisville H. C. & W	5
Mississippi	Ripley	26
Ohio	Painesville and Youngstown	12
Pennsylvania	Montrose	22½
Utah	Utah Northern	33
"	" Southern	31
"	American Fork	18
Total		544

Some of the railways above enumerated are for coal or mineral transportation alone. The most notable of those answering all the ordinary purposes of railway transportation are those in operation in the territories of Colorado and Utah, which, in fact, represent one-half of all the narrow gauge track in this country. In discussing the practical workings and utility of the narrow gauge system of railways, we are to take into account cost of construction, of maintenance and operation, carrying capacity, speed, and safety. And it will be proper, too, to add such minor details of expense, adaptability, and profit, as may bear upon the subject under consideration. The Denver and Rio Grande railway, stretching along the eastern base of the Rocky mountains, is in operation from Denver to Pueblo, with a branch up the Arkansas to Cañon City, in all 156 miles. The cost of construction, including stations, snow-sheds, fences, ballasting, car and machine shops, hotels, offices, and every appurtenance for business, has been $14,000 per mile; while the Kansas Pacific, broad gauge, going through a similar country, and built under the same engineers, and for the most part by the same contractors, cost $22,000. The Rio Grande road, however, had some advantage in cheaper labor and more ready access to ties. It is the estimate of the managers of this enterprise that they saved 37½ per cent. in first cost of construction and equipment by adopting the 3 instead of the 4-foot 8½-inch gauge. The facts about the carrying capacity of the road may be stated as follows: The road is at present supplied with 13 locomotives, 8 passenger, 4 baggage, 258 freight, and 22 dump cars. The road is doing a general passenger and freight business, carrying, besides ordinary merchandise, live stock, lumber, wool, coal, building stone, and in fact every class of freight. The passenger cars accommodate 38 to 40 persons each, the freight and coal cars 8 tons. A broad gauge cattle car will carry 14 head of cattle, a narrow gauge car 9. An ordinary passenger train consists of 4 cars, an ordinary freight train of 15. Between Denver and Colorado springs, a distance of 76 miles, there is an ascent of 2,000 feet. Lately a Fairlie engine hauled a loaded train of 60 cars over this line.

It is claimed, as a matter of experience, that there is no class of freight upon which the proportion of paying to non-paying weight has not been in favor of the narrow gauge as compared with the wide. This may be illustrated by the following table:—

Cars.	*Weight empty.*	*Paying load.*	*Total dead weight.*	*Total paying weight.*	*Total weight cars & load.*
16 wide gauge............	8½ tons each.	10 tons each.	136 tons.	160 tons.	296 tons.
20 narrow gauge.........	Less than 3 tons each.	8 tons each.	60 tons.	160 tons.	220 tons.
Saving in total weight (for narrow gauge)........					76 tons.

As to speed, which many urge as an argument against the narrow gauge, it may be said that the Denver and Rio Grande maintains a passenger schedule of 18 miles per hour, and a freight schedule of 12; but frequently, during the past year, 30 and even 40 miles per hour have been made by passenger trains with comparative ease. The policy of railway companies, however, has of late years been to reduce speed. The express traffic in England is now done at 35 to 40 miles per hour, and the general traffic at 22. In this country the rates of speed are much lower, and it is found that the narrow gauge meets all the necessary requirements. As to safety, which is an important item in railway economy, it may be said that in the almost two years that the Denver and Rio Grande railway has been in operation, there has been but one accident to a passenger train, (that by a car being blown from the track), and no freight trains have been wrecked. The general operation of the road may be seen from the following statement for the year 1872 (covering the first division of the road 76 miles):—

Earnings.		*Expenses.*	
From freight	$172,103 23	Conducting transportation	$63,160 44
" passengers	134,391 56	Motive power	62,311 73
Miscellaneous	1,645 03	Maintenance of cars	4,885 95
		" of way	55,660 13
		General expenses	15,526 60
Total	$308,138 82		
Net profits	106,593 97		$201,544 85

The number of passengers carried was 25,168, and the number of tons of freight, 47,598. During the first three months of 1873 the net profits of the road were $36,855.55, and the proportion of expenses to earnings was 54 per cent. The gross earnings for the current year are estimated at $500,000, and it is believed that the road will be operated on 50 per cent. of its gross earnings. This is a better showing than the best managed broad gauge railways are able to exhibit.

The success of the Denver and Rio Grande railway has stimulated its managers to an early completion of their projected system, which embraces a continuous line from Denver *via* Santa Fé and Albuquerque to the City of Mexico—1,720 miles. A branch is also under construction from Pueblo to Trinidad, near the southern boundary of Colorado. Other enterprises have also grown out of this, and the Golden and South Platte, Denver, South Park and Pacific and Colorado Central extension are among the narrow gauge railways now under construction in the territory, while the Leavenworth and Denver line has contracted for the building of 200 miles more of their road. In Utah several lines are being constructed and a number projected. An important consideration in favor of the narrow gauge system is the comparative ease with which it can meet its burden of interest. If it costs but three-fifths of the broad gauge, it has to meet but three-fifths as much interest, and is free from that danger which threatens so many railways. Cheaply built and cheaply operated, and yet meeting all the requirements of transportation, the safety of money invested in narrow gauge bonds is, to that invested in similar broad gauge security, as five is to three.

In a leading article on narrow-gauge railways, drawn out by a review of Mr. Fairlie's book on that subject, the London Times says: "On the occasion of the proposed construction of the Texas Pacific railway, Hon. Silas Seymour, of New York, was appealed to by the directors on the question of gauge, and prepared for them a document, in which he not only advocated the broad gauge, but also, unfortunately for himself, assigned his reasons for doing so. Mr. Fairlie took advantage of the opportunity thus afforded him, and published his treatise, the 'Battle of the Gauges,' in reply to Mr. Seymour's arguments, of which, from beginning to end, it is a masterly and crushing refutation. Mr. Fairlie shows conclusively, and as much by experience as by reasoning, that a gauge of from 3 feet to 3 feet 6 inches is that which best satisfies all the requirements of the case, and affords the largest relative capacity for traffic at the smallest cost for construction and maintenance."

TABLE FOR THE REDUCTION OF STERLING MONEY OF GREAT BRITAIN TO UNITED STATES GOLD COIN,

UNDER ACT APPROVED MARCH 3, 1873, FIXING THE VALUE OF THE £ STERLING AT $4.8665.

Prepared by the First Comptroller of the Treasury, April 1, 1873.

	0	1	2	3	4	5	6	7	8	9
£1	$4.8665	53.5315	58.398	63.2645	68.131	72.9975	77.864	82.7305	87.597	92.4635
2	9.733	102.1965	107.063	111.9295	116.796	121.6625	126.529	131.3955	136.262	141.1285
3	14.5995	150.8615	155.728	160.5945	165.461	170.3275	175.194	180.0605	184.927	189.7935
4	19.466	199.5265	204.393	209.2595	214.126	218.9925	223.859	228.7255	233.592	238.4585
5	24.3325	248.1915	253.058	257.9245	262.791	267.6575	272.524	277.3905	282.257	287.1235
6	29.199	296.8565	301.723	306.5895	311.456	316.3225	321.189	326.0555	330.922	335.7885
7	34.0655	345.5215	350,388	355.2545	360.121	364.9875	369.854	374.7205	379.587	384 4535
8	38.932	394.1865	399.053	403.9195	408.786	413.6525	418.519	423.3855	428.252	433.1185
9	43.7985	442.8515	447.718	452.5845	457.451	462.3175	467.184	472.0505	476.917	481.7835

NOTE.—To find the value of any number of pounds represented by one figure, find the figure in the left-hand margin of the table, and its value will appear in the column adjoining, opposite that figure. To find the value when expressed by two figures, look for the *tens* in the left-hand column, and for the *units* in the top margin, and the value will be shown in the place where the two columns meet: thus, the value of £57 is $277.3905. To find the value of £576, look for 57 as before, and move the decimal point one place to the right, and it shows $2773.905; then add £6 as already shown, $29.199, and it gives the sum of $2803.104.

ONE SHILLING EQUALS $24\frac{133}{400}$ CENTS. ONE PENNY EQUALS $2\frac{133}{4800}$ CENTS.

	s.0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*
d.0	...	.24	.48	.73	.97	1.21	1.46	1.70	1.94	2.19	2.43	2.67	2.92	3.16	3.40	3.65	3.89	4.13	4.38	4.62
1	.02	.26	.50	.75	.99	1.23	1.48	1.72	1.96	2.21	2.45	2.69	2.94	3.18	3.42	3.67	3.91	4.15	4.40	4.64
2	.04	.28	.52	.77	1.01	1.25	1.50	1.74	1.98	2.23	2.47	2.71	2.96	3.20	3.44	3.69	3.93	4.17	4.42	4.66
3	.06	.30	.54	.79	1.03	1.27	1.52	1.76	2.00	2.25	2.49	2.73	2.98	3.22	3.46	3.71	3.95	4.19	4.44	4.68
4	.08	.32	.56	.81	1.05	1.29	1.54	1.78	2.02	2.27	2.51	2.75	3.00	3.24	3.48	3.73	3.97	4.21	4.46	4.70
5	.10	.34	.58	.83	1.07	1.31	1.56	1.80	2.04	2.29	2.53	2.77	3.02	3.26	3.50	3.75	3.99	4.23	4.48	4.72
6	.12	.36	.60	.85	1.09	1.33	1.58	1.82	2.06	2.31	2.55	2.79	3.04	3.28	3.52	3.77	4.01	4.25	4.50	4.74
7	.14	.38	.62	.87	1.11	1.35	1.60	1.84	2.08	2.33	2.57	2.81	3.06	3.30	3.54	3.79	4.03	4.27	4.52	4.76
8	.16	.40	.64	.89	1.13	1.37	1.62	1.86	2.10	2.35	2.59	2.83	3.08	3.32	3.56	3.81	4.05	4.29	4.54	4.78
9	.18	.42	.66	.91	1.15	1.39	1.64	1.88	2.12	2.37	2.61	2.85	3.10	3.34	3.58	3.83	4.07	4.31	4.56	4.80
10	.20	.44	.68	.93	1.17	1.41	1.66	1.90	2.14	2.39	2.63	2.87	3.12	3.36	3.60	3.85	4.09	4.33	4.58	4.82
11	.22	.46	.70	.95	1.19	1.43	1.68	1.92	2.16	2.41	2.65	2.89	3.14	3.38	3.62	3.87	4.11	4.35	4.60	4.84

NOTE.—This table shows the value of every combination of shillings and pence less than £1; the upper margin representing the shillings, and the left-hand margin the pence. Thus, to find the value of 17 shillings and 6 pence, follow the column 17 downward until it meets the left-hand column opposite 6, and it shows $4.25. By this method any number of pounds, shillings, and pence can be reduced to United States gold coin quickly and accurately.

MINING AND METALLURGY.

[This Department is under the editorial charge of THOS. M. DROWN, Analytical Chemist and Consulting Metallurgist, Philadelphia.]

THE blast-furnace process is receiving, at present, the attention that subject deserves. No industrial operation presents a more extended and varied field for scientific investigations than that of the reduction of iron from its ore. The results of these investigations are, moreover, such as can be universally appreciated, for they all bear immediately on the important question of cost of production. It is rare to find a technical process the subject of exhaustive scientific treatise, but the magnitude and importance of the iron industry in the world sufficiently accounts for the attention it receives from scientists. Among the latest contributions to the study of the blast-furnace process is that of Prof. Gruner, of the *Ecole des Mines*, Paris. The result of his studies we translate as follows:—

1st. The production of large blast-furnaces, exceeding 200 cubic metres (7,064 cubic feet) capacity, does not increase in proportion to the capacity.

2d. In order to form an estimate of the working of a blast-furnace it is important to determine experimentally the proportion $CO^2 : CO$ in the tunnel head gases. By means of this proportion we can not only calculate the actual composition of the gases, but also the quantity of air that the furnace requires.

3d. To determine precisely the proportion $CO_2 : CO$, it does not suffice to take a number of samples instantaneously, but the gases must be drawn off for several hours.

4th. The composition of the gases being known, it is desirable, in order to exhibit an exact account of the working of the furnace, to strike a balance between the heat *received* and that *expended*, and to estimate separately the heat developed in the zone of the tuyeres and that generated in the zone of reduction.

5th. In applying these principles to some of the Cleveland furnaces it can be proved that the advantages of high furnaces over low ones result simply from a lower temperature in the upper portion of the shaft. The reduction is accomplished there more thoroughly by the sole action of carbonic oxide without the intervention of solid carbon; approximating to the *ideal* working, which supposes the solid carbon to be burnt exclusively by the oxygen of the blast. A subordinate, though more immediate advantage, is due to the less amount of *sensible* heat in the tunnel head gases.

6th. The consumption of fuel in the blast-furnace depends in part on its production. The *minimum* consumption accompanies a *mean* rapidity of working, which varies, moreover, with the height and capacity of the furnace.

7th. On account of the dissociation of carbonic oxide in the upper part of the furnace, the temperature of the tunnel head gases cannot be reduced beyond a certain limit, and, on this account, there is no advantage, where this limit is attained, in increasing the capacity and height of the furnace. Too slow working and an excessive capacity may become embarrassing.

8th. The heat carried by the blast replaces with advantage that developed by combustion in the tuyere zone. The relative economy of the hot-blast diminishes, however, in proportion as the temperature is raised. In practice, the actual economy is slight beyond 700° to 800° C. (1,292° to 1,472° F.). Hot-blast tends to increase the value of the proportion $CO_2 : CO$; and, in consequence of the cooling of the upper part of the furnace, it facilitates reduction without the consumption of solid carbon, which constitutes the ideal working of the furnace.

——THE Hunt and Douglas wet copper process has been in regular operation at the Ore Knob copper mine, Ashe county, N. C., with very favorable results. This process depends on the power of protochloride of iron to chloridize, and, in the presence of strong brine, to dissolve oxide of copper, while the precipitation of the metallic copper from this solution by means of metallic iron regenerates the protochloride of iron. Mr. James E. Clayton writes to the inventors of this method the following account of the practical working of the process: "The ore to be treated was a copper pyrites of low grade, dressed to contain from 100 to 120 pounds of copper to the ton of 2,000 lbs.; the gangue was a clay slate. Our mode of treatment was as follows: The ores were crushed, sized by being passed through a sieve of forty holes to the linear inch, and sent to the calcining furnaces. These furnaces were simple three-hearth reverberatories, and were charged every eight hours with 2,000 pounds of prepared ore; the charges, after being in the furnace for twenty-four hours, were withdrawn, weighed, assayed, and sent to the tanks. The calcination was effected at a low red heat, with a view of converting about one-third of the copper in the charge into sulphate; the remainder being as oxides, with the exception of from 5 to 7½ pounds to the ton remaining as unoxidized sulphuret. The calcined ore was next charged into tanks of about 3,000 gallons capacity, two-thirds filled with bath, in weighed portions of 3,000 pounds. The mixture was then agitated by a stirring apparatus connected with the tanks, and steam injected in sufficient quantity to raise the temperature to about 120° F. After eight hours' stirring the mixture was allowed to subside, the copper solution drawn off into settling tanks, and about 600 gallons of weak bath drawn down upon the residues remaining in each stirring tank, to cleanse them of the copper-liquor. This weak bath was then drawn off into tanks containing metallic iron, the copper precipitated therefrom, and the liquid passed into a reservoir-tank to be again used in washing the residue from the following charge. The stirring-tanks were then emptied and the residues wheeled away. The general average of loss in these residues was from 6 to 10 pounds of copper to the ton of ore treated. The strong copper solution, after fully subsiding in the settling-tanks, was drawn into tanks containing iron, (cast or wrought iron scrap), the copper precipitated, and the bath, with a small addition of salt, used in the treatment of a new charge of roasted ore. We, in the first start, prepared a given amount of bath, according to your formula, with copperas and salt, and found, in working the process, that by calcining the ores at a low red heat, avoiding a dead roast, and bringing from 25 to 33 per cent. of copper into sulphate, the bath was easily kept at standard strength without the addition of any copperas whatever. The salt added was equal to 25 per cent., and the maximum of iron consumed to 70 per cent. of the copper produced. Our cost of making copper, obtained as cement, exclusive of mining and dressing the ores, was as follows—estimating the ores at the general average of 5½ per cent., and the quantity treated daily at 21 tons of 2,000 pounds, yielding, with the allowance of ½ per cent. for loss, 2,100 pounds of copper. The roasting requires ⅓ of a cord of wood to the ton of ore:—

7 cords of wood at $1 per cord	$7 00
21 men at 7 furnaces at $1	21 00
4 men charging furnaces and tanks at 75 cents	3 00
4 men emptying tanks and removing residues at 75 cents	3 00
2 men attending tanks at $1	2 00
Foreman	2 00
Chemist	3 00
525 pounds salt at 1¼ cents	6 56
1,470 pounds iron at 2 cents	29 40
	76 96

"The above estimate, which makes the cost of producing 2,100 pounds of copper from 21 tons of

5½ per cent. ores, equal to 3⅔ cents per pound, is based on the prices of labor and fuel in Davidson county. The cost of plant required is small. The furnaces are simple and inexpensive in construction, and require about 25,000 bricks each. The tanks cost, complete, about $60 each, and the labor employed need not be skilled nor high-priced, as the ordinary laborers of the country can in a short time be trained to the routine of the work."

——DR. T. STERRY HUNT, in a communication to the Engineering and Mining Journal, gives an interesting description of the reopening of the Ore Knob copper mine, near New river, in the north-west county of North Carolina: "Mining operations were begun here before the rebellion, and a considerable quantity of rich copper ore extracted, but the mine was for some reason abandoned. Within the last three months it has been reopened by Messrs. S. S. & J. E. Clayton, of Baltimore, with remarkable results. The ore deposit, which appears to be a true fissure lode, cuts vertically the moderately inclined strata of gneiss and mica schist of the Blue Ridge, which have the lithological characters of what I have called the White Mountain or Montalban series. Both the country rock and the lode are, as is usual in this region, decomposed to considerable depth, and the latter exhibits a cap of from fifty to seventy feet of gossan, or hydrous peroxide of iron, which, in its lower part, is highly charged with oxide and carbonate of copper, and rests directly on the unchanged sulphurets of the lode. The out-crop has been traced for 1,900 feet in a north-east and south-west direction, but the unchanged ore is as yet exposed only for a distance of 661 feet in five shafts—one of which is new, while the others are old workings. These have just been reopened, and operations commenced in two of them, in one of which the solid ore has now been penetrated to a depth of twenty-four feet. Unfinished drifts have been completed, opening a level of 220 feet wholly in the vein, which consists of solid sulphuretted ores, almost without admixture. On several parts of the drift the north-west wall has been exposed, and in two places the opposite wall has been reached by cross-cuts, showing the lode to have here a breadth of fourteen feet and nine feet. The bottom of the deepest shaft is eleven feet wide, and the sides are, like the floor, solid ore. In the other parts from six to eight feet are seen, with an undetermined thickness of ore on one or both sides of the level. The out-crop of gossan is in many places from fifteen to twenty feet in width. In this remarkable deposit the copper ores themselves may be said to form the vein stone. If we except a layer of a few inches of vitreous quartz, carrying a large portion of variegated ore, which has been observed at some points along the exposed or north-west wall, the filling of the vein consists of yellow and variegated copper ores, through which are disseminated portions of quartz, magnetic iron, and some other foreign minerals. In the part of the vein now being removed there is a breadth of from three to four feet of an iron-black, friable, drusy, crystalline, sulphuretted ore, enclosing grains of quartz, garnet, and magnetite, besides a black non-magnetic mineral not attacked by nitric acid. The mass yields about 36 per cent. of copper."

Dr. Hunt describes likewise the copper deposit of Polk county, Tennessee, known as the Ducktown copper mine. This deposit has long been known and extensively worked. Dr. Hunt calls attention to this mine as a source of sulphur as well as copper. He writes: "The Ducktown lodes are, however, valuable, not only for their immense stores of copper, but as a source of sulphur. The massive ores now broken and smelted for copper would probably yield 30 per cent. of sulphur; and, were sulphur alone the object, there are great portions of the lodes in which cubic pyrites predominate over the pyrrhotine, often to the exclusion of the latter, giving rise to nearly pure bisulphide of iron, with 50 per cent. or more of sulphur. The sulphur for the acid manufacture of Great Britain is now in large part supplied by pyrites chiefly from Spain, while the acid works of this country are still for the most part dependent on Sicilian sulphur, for the reason that available deposits of pyrites are not accessible to our manufacturers. At the present time sulphur ores from Ontario and from Quebec are brought to the vicinity of New York; and pyrites from the vicinity of Richmond, Va., is transported to Philadelphia, where it is made into sulphuric acid for the treatment of the mineral phosphates brought from Charleston, S. C., the manufactured super-phosphate of lime being shipped southward to enrich the cotton lands of South Carolina and Georgia. The great importance of this substance as a fertilizer, and the desirableness of manufacturing it in the

South, and with the sulphur which abounds there, has already attracted the attention of clear-sighted men, who have looked forward to the extension of a railway from Walhalla, S. C., across the mountains of the Blue Ridge to Ducktown, thus bringing the phosphates of the sea-board in direct communication with the sulphur ores of Ducktown. The sulphur which these ores contain is lost in the present mode of treating them; but it is to be noted that pyrites, holding but a small portion of copper, may be used with great advantage in the manufacture of acid, since the copper extracted from the residues may be made to pay the whole cost of the pyrites."

——MANGANESE, it would appear, is the "coming metal." In view of the high price of nickel, Dr. Percy makes the following interesting communication to the London Times: "With your permission I will now disclose, for the first time, a fact which may perhaps surprise, and will certainly interest, electro-platers. More than twenty years ago I was engaged at the largest German silver works in this country in an investigation which had for its object the discovery, if possible, of a substitute for nickel in German silver. The result was successful; every difficulty was surmounted, and an alloy was produced on a manufacturing scale which so perfectly resembled German silver that it was sold as such, by way of experiment, to electro-platers accustomed to the use of that alloy, without their discovering the difference between the two. The subject was the metal manganese; and, although this metal cost very much less than nickel, yet it was decided, for commercial reasons, not to proceed further in the matter, the manufacture of German silver being at the time highly remunerative. The firm to which I have alluded has it in its power at any time to introduce the manganese alloy, and if it should be unwilling to do so, it will certainly be done by other persons. At present I refrain from making known either the composition of the alloy or the details necessary to guide the manufacture, though it is my intention to publish both on a future occasion. What I here announce will, I trust, serve as a hint to practical metallurgists, and may induce them to work at the subject."

We await the second communication of Dr. Percy with much interest, particularly, as it is stated that the firm for whom the experiments were made deny the favorable results which the doctor claims, and say that the experiments were in every way a failure. The investigations of Hugo Tamm have added greatly to our knowledge of the metallurgy of manganese, and we may reasonably hope that this metal will, before long, be in regular use in various alloys. In an interesting paper read before the British Association in 1870, Mr. J. Fenwick Allen, F.C.S., described various alloys of manganese with copper, tin, zinc, and lead. He found the alloy with copper ranging from 5 to 30 per cent. of manganese, both malleable and ductile, and possessing a tenacity considerably greater than copper. With zinc, copper, and manganese, an alloy was formed resembling in some of its qualities—not the best—German silver. The alloy of copper and manganese was found to combine with lead and other metals, and from these castings were made, which were applied as bearings for machinery. In the present state of the nickel market there is surely incentive enough for metallurgists to pursue the investigation.

——MR. CHARLES WOOD, of the Tees iron works, who has lately been so successful in the manipulation of blast-furnace slag, has succeeded in granulating pig iron in the same machine employed for granulating slag. The object of this granulation is to furnish a product suitable for melting in Danks's puddler. One of the greatest drawbacks to the use of Danks's machine has been the cost of melting iron when charged in form of pigs. These cannot be turned over without damaging the lining of the furnace. The use of granulated iron will, it is hoped, obviate this disadvantage, and permit the puddling machine to be rotated as soon as charged, while the iron, being in small fragments, will melt more quickly.

——COMMISSIONER DRUMMOND, of the General Land Office, has decided that lands valuable on account of deposits of carbonate of soda, nitrate of soda, sulphur, alum, and salt, may be patented under the mining act of May 10th, 1872, as well as other valuable mineral deposits, except those specially reserved by act of Congress.——THE Bethlehem (Pa.) Iron Company has for some time been receiving iron ore from Africa. It consists of a mixture of hematite and magnetite. It is mined at Elmoken, Algiers, and shipped from the seaport town of Bona, in the same province, direct to Philadelphia.

——MR. J. J. HAGERMAN, secretary of the Milwaukee Iron Company, communicates to the Bulletin of the American Iron and Steel Association the production of two of the company's furnaces for the last three and four years respectively. The furnaces are still in blast, and "apparently as good as ever":—

NO. 1 FURNACE.

	Months.	*Tons of* 2,268 *lbs.*
1870	8	11,314
1871	12	15,553
1872	12	16,231
1873	6	8,325
Total		51,123

Averaging over 1,353 tons per month.

NO. 2 FURNACE.

	Months.	*Tons of* 2,268 *lbs.*
1871	7½	9,448
1872	12	16,614
1873	6	8,674
Total		34,736

Averaging over 1,362 tons per month.

——ADVICES from Colorado represent silver mining in the territory to be very active and remunerative. A large number of mines which have been lying idle for some time are now being profitably worked. The era of wild speculation has been succeeded by calm, intelligent working, with gratifying results. The yield of ore varies from $40 to $200 per ton in the smelting works.

The Caribou mill, Colorado, has recently established the following scale of prices for the treatment of silver ore: For 60 ozs. ore, $1.20 for all over 30 ozs.; for 80 ozs. ore, $1.21 for all over 29 ozs; for 100 ozs. ore, $1.23 for all over 25 ozs. In other words, the price paid for 100 ozs. ore is $92 per ton. The mill has four Buckner cylinders and appurtenances, and will ere long be doubled in capacity.

Mining in Idaho is likewise represented as flourishing. The Owyhee Avalanche of July 5th reports: "Our mines are all looking more promising than ever, and every available stamp in camp is busily pounding ore. During the week ending yesterday, Wells, Fargo & Co. shipped from here 30 bars of bullion, valued at $77,246.88.

——A SERIES of interesting experiments were made at the Troy Bessemer works in February, 1872, to determine the feasibility of replacing spiegeleisen by a pig iron rich in silicon. These experiments were tried at the instance of Mr. R. H. Terhune. The pig iron used was either Poughkeepsie or Durham, both containing a high percentage of silicon, the latter between 5 and 6 per cent. In the first trial 5.3 per cent. spiegeleisen and 1.3 per cent. Poughkeepsie iron were used to recarburize the iron, and the ingots rolled well. In the second trial 2.6 per cent. Poughkeepsie and 4 per cent. spiegeleisen were used, and the ingots rolled "pretty well." In the third trial 4 per cent. Poughkeepsie and 2.6 per cent. spiegeleisen caused the ingots to crack on rolling; and in the fourth, with 4 per cent. spiegeleisen and 2.6 per cent. Durham, the ingots rolled well. The cause of the red shortness, where a large quantity of the highly siliconized pig was used, was not determined. It may have resulted either from unreduced oxide of iron or from an excess of silicon.

——THE Steel Ore Company of Pottstown, Montgomery county, Pa., has recently been developing the extensive deposits of magnetic iron ore at Boyertown, Berks county, Pa. The "breast" of ore at the head of their mining slopes is 50 feet thick, and in 700 feet run of the vein it has thickened to 150 feet, as shown by the perpendicular boring of 211 feet in it. The drill stopped in ore at 588 feet in depth, and had not reached the old red sandstone lying on the bed rock. The black cores obtained by drilling from the fourth ore bench yielded, on analysis, 58.58 per cent. metallic iron, and but traces of phosphorus.

INSURANCE.

THE greater promptitude in paying to capitalists profits actually made, great or small, so that they can have the immediate benefit thereof, the greater will be the inducement to invest money in the hope of such profits. And after all, notwithstanding what may be said of the apparent necessity of leaving portions of profits on insurance capital on deposit for provision against extraordinary emergency, it is doubtful if any rule of law or voluntary agreement can be made which will be wholly adequate. The world cannot be indemnified against all possible calamities. Earthquakes have happened in territory distinguished for steadiness and gravity. Mankind must assume some risks; and when that portion of it which seeks the protection of the insurance companies has been for many years satisfied in being reimbursed for all ordinary losses encounters a disaster as great or greater than that which swept our sister city, [Chicago,] it must be expected that even insurers are not insured, and that such universal losses, which occur once in a life-time, cannot be provided for by the light of any experience.—*Fourth Annual Report, Missouri Insurance Department.*

Superintendent Selby has done so well in his suggestion as to converting the fire reinsurance reserve into a safeguard of adequate premium rating, that we regret there should be occasion for us to pick out the folly here cited. It is, however, not the first time that such an enunciation has been made, and happily it needs only effective inculcation to relieve the official brain and public apprehension of all worry about fire insurance problems: for we presume that with the removal of the great incentive to fire insurance reliance, the practice of it, and the debates relating thereto, will alike come to an end. By a little knowledge of the history of his subject the superintendent would have escaped committing himself to such a heresy. Our fire insurance did not have its origin in the ordinary fire occurrences, but in a great, extraordinary conflagration. American fire underwriting, at least in its beginning, was a copy of that of England. When, in 1666, the flames laid five-sixths of London in ashes, the people of the city first sought out a relief and remedy for such occurrences, and next year the insurance of houses (and some authorities say of goods) began there in a crude form. The animus then prompting fire insurance use was its applicability to a wide-spread destruction ranging beyond the calamities of isolated individuals. Now, after two centuries of practice, the Missouri department informs us that the originators of our fire insurance ought to have known that "such universal losses cannot be provided for." But they did not know it, and fortunately there was no one to teach them.

But, passing from the historic argument, fire insurance is—insurance, or it is nothing. As an insurance (not a contingency), it is an essential concomitant of productive capital in the present organization of our commercial economy. Its value is beyond the indemnity it promises, in this: that it makes the opportunity for the industrial and trade use of wealth by averting from it a hazard it cannot afford to assume. The principle that the value of capital so employed is not destructible by fire, is a power that acts, works, and builds. A century ago Magens told what resulted to the merchants of London from the general practice of fire insurance after the great fire, viz.: "This *precaution* adds to their credit both at home and abroad, when it is known that their great capitals, lying in their houses and warehouses, are thus *secured* from the flames." The insured is a responsible man—the uninsured is not. But, when there is a flaw in the confidence or a breach in the security, the validity of the principle is gone. Where the property of one policyholder burns, the properties of ninety-nine others do not. The Missouri theory of contingent indemnity destroys all the value of insurance to the ninety-nine, and takes half its worth away from the remaining one.

Every man who is insured knows that the danger of fire overtaking his material property is a very small fraction of a probability, yet, on account of that small fraction, he pays his premium; now array against this payment the small fraction of a chance that the payment is useless, and common sense is against the insurance.

When anyone falls into a train of false reasoning, one thought is apt to contradict another. The contradictions of the sentences we have quoted will be apparent upon a second reading. Between Chicago and Boston, respectively in flames, the period was so short that it can hardly be a "lifetime," even in Missouri. Therefore, though a Chicago cannot now be reimbursed, if a Boston can, the entirety of indemnity is surely not beyond the reach of hope.

"The world cannot be indemnified against all possible calamities," is a truism not very startling, but it has no relevancy to the subject. Chicago, Boston, &c., are facts of experience—not unrealized possibilities. However it may have been some years ago, such conflagrations now are within the probabilities upon which the insurer writes. They must enter into the calculations of his premiums and distributions. They are to him not miraculous marvels, but simple revelations of the American fire hazard. A hundred-million fire to-day is but the relative equivalent of a less than ten-million fire thirty years ago. As there are ten times more to burn now than then, through the compacting of values, ten times more burns. A hundred-million fire in some city of the United States is possible this year—it is probable the next ten years. It is a question of aggregating augmented resources to meet heightened emergencies. Say the hundred-million fire loss involves a sixty-million insurance loss. There are $6,000,000,000 insured against loss by fire in the United States. One per cent. of the sum insured pays the loss, and distributing through ten years one-tenth of one per cent. annually is the full provision required. Suppose a fire involving the yet unapproached insurance loss of one hundred and twenty million dollars, one-fifth of one per cent. annually gives the indemnity upon the basis presented. An average of twenty cents per year out of every hundred dollars of insured value in the country is certainly a fearful tax to pay for the maximum fire of a decade; but it is collectible, and being collectible, the alternative is between it and a vast depreciation of our mercantile trade and manufacturing industries. Such an alternative offers no dilemma—there is not a tittle of reason for a moment's hesitancy. Whatever the annual fire loss may be, it must be paid by the public through the premium collectors and distributors—the insurance companies. When the people *decide*, with consistent action, to prefer the cost (in money, labor, devices, efforts, and severe municipal regulations,) of preventing fires and their extension to paying the augmenting fire losses, our destructive combustion will be upon such a reduced scale that the premium pittance will scarcely trouble the payer.

That our fire insurance is inadequately organized for the contingencies besetting it is gradually becoming known, but it is developing in the right direction—that of combining the resources of the country for the fire exigency. There is the drawback of unnecessary companies, the expense of which needlessly absorbs part of the fund wanted for the losses. Public patronage should concentrate upon those companies whose managements have shown ability to cope with the fire crisis. Whether rural, agricultural districts should contribute to the fire cost of cities, towns, and villages —*i. e.*, whether paltry agencies for such districts would be cheaper than participation in the great national insurance work—may be an open question; but a company insuring solely in a single city, or but in the immediate urban vicinity of its official quarters, is simply an impediment to the right combination in the business. It not only runs on chance itself, but it is in the road of the growth of real insurance companies. Such a company had its use in the past, but its day is over. Fire here, fire there, fires at all points of the compass, in appalling magnitude, end the plea, "We can exist because no great fires will happen within our borders." The "mankind" which "must assume some risks" are not in a humor to say, "The companies can pay the small losses, while we will bear the biggest ones—outside of the companies." Then there is a difficulty in making the small scale of one-city insurance provide the expenses of conducting the business, apart from the demands of the ordinary losses. Though opposing such narrow underwriting, Mr. Selby has hit upon the argument by which exclusively local insurance would attempt to excuse its existence, and applied it where it does not belong. The fire liability is a dread portent, like a gigantic fiend seen only in the huge expanding outlines of his threatening shadow; the danger is common to all —the next great havoc will be where no one now knows—the unit of liability calls for the unit of asset, and the nation must unite in common contribution, through a select body of the companies, to protect against the common danger, with the fewest possible divertings from the general movement; then such general losses which do occur "once in a life-time" *could* "be provided for."

——In the issue of this Review for January of the present year there was an exhibit of the characteristics of a Michigan State mortality table for males, with respect to which our conclusion was that "it is no life table at all," and "that the figures of age and death have been collected upon a hap-hazard arrangement, without any governing principle or system to secure due harmony of proportion." This table was constructed chiefly from data afforded by the fourth State registration of births, marriages, and deaths (1870), and though, if correct, but the death movement of a single year, was held by its compiler to be "nearest the truth"—nearer the actual mortality of Michigan than any other existing tabulation. We have now received another "Life Table for Males, constructed upon the basis of the death-rate in Michigan during the year 1870," by the same compiler, which appears in the "Statistics of the State of Michigan, collected for the Ninth Census of the United States, June 1, 1870." This second table is an improvement on the first, if not a correction of it—omissions in the registration being supplied by the census data, and in connection with which there is the rather naive and cool confession of "deaths increased because of evidence that only about 54 per cent. of the deaths are returned." While experience teaches, and higher knowledge destroys the confidence begotten of ignorance, the language improves by being shorn of its boastings, and we are, with good taste and judgment, informed that the "statements" in the second table, No. 8, "may be accepted as the nearest approaches to the truth which it has been practicable for the writer to reach with the material at hand. It is not maintained that they are perfect, but it is expected that further researches will modify the table in some if not in many important particulars. It is given with a belief that its statements are nearer the truth than those in a similar table in Vital Statistics in Michigan—Table 7—which was constructed from similar material, but before it had been subjected to any correction or equalization."

We make another extract:—

> Tables 5 [number of males at each age] and 6 [females] reveal the fact that there are general laws which apply to some, at least, of the inaccuracies in the statements of the age of the inhabitants by census enumerators. These laws of method result from the tendency to state the age approximately in "round numbers," instead of accurately. The first general rule is that many more are stated to be aged even, than odd years. The exceptions to this rule are mainly according to another, which is that the importance and facility of expression of certain ages, such as 25, 35, 45, etc., will overcome the tendency to the first mentioned error and cause one in a contrary direction, showing a number greater than the true one at such ages. When the important age is an even year, such as 40, 50, 60, etc., the combined action of these first two rules results in a third class of errors, which are so intensified as to become astonishingly manifest when the number of inhabitants is compiled by age in single years, as in tables 5 and 6, from an examination of which it will be seen that, if we were to believe the returns, we should conclude that there were more than twice as many of either sex aged 40, than there were aged 41, &c. The material in table 5 was used in the construction of a "life table" for males—table 7—of Michigan, 1870; and the above described displacements of the numbers seriously marred the appearance of the table, although they did not so materially affect the statements of the "expectation of life" at the various ages as might at first seem probable. There are so many real inequalities in the number of inhabitants at the successive ages, that it becomes almost or quite impossible to so correct and equalize them as to represent the true number living at each age.

Table No. 7, we remark, showed for 100,000 lives at age 10 but 15,051 deaths by age 50; while table No. 8 shows for 100,000 lives at age 10, 25,529 deaths, which difference of 10,478 we think a rather considerable affair. Had a life company done a business upon an adjusted No. 7 as its expected mortality, and realized No. 8 in its experience, it would have reached a depth of bankruptcy that no financial plummet has ever sounded. The standard American Experience gives 31,196 deaths by age 50 in 100,000 lives at age 10, and that more than two-thirds of the births in the United States that reach the age of 10 survive to the age of 50 we regard as far from being proved.

The comparative years of Expectation of Life by the three tables we have referred to is as follows for the ages given:—

	AGE								
	10	20	30	40	50	60	70	80	95
American Experience.........	48.72	42.20	35.33	28.18	20.91	14.09	8.48	4 38	.50
Michigan No. 8...............	51.34	43.72	36.62	28.96	21.50	15.06	9.19	5.87	3.53
Michigan No. 7...............	60.76	52.31	44.18	35.70	27.54	20.12	13.48	9.25	5.40

In what we have said it is far from our purpose to decry the statistic work of Michigan; on the contrary, it deserves the highest praise as a wise and thoughtful measure—the earnest effort of a State to conduct its affairs upon a basis of ascertained facts, and not to proceed with its public administration, as so much public administration is done, in the dark. Realizing, as the volume before us shows, that there is a need of adequate laws for statistic collection—framed by statisticians, not by politicians—we see the germs here of a great ultimate fruitage. Our criticism is simply a monition not to attempt to pluck the fruit before it is ripe by proving too much.

The American death-rate is a question beyond the range of any superficial mechanical actuarialism. It partakes much of the character of an ethnological problem. The American hemisphere is the grave of extinct peoples. Populations, however, decrease numerically by national decline as well as by mortality, and it is possible that the obliteration of a people may take place without any increment of death-rate; but concerning this we have no adequate data upon which to speak. It is, however, by long operating causes that collective man dies, not by sudden catastrophes, short from their very violence. Whether man is essentially an exotic on the American half of the globe, having his origin in the east, and ultimately to lose his vitality in the west, is a combined ethnologic and antiquarian puzzle from which, as yet, no certain conclusions can be drawn; but it may be regarded as evident that the historically aboriginal races are dying out both in South and North America—even where, in the former, they control the social regulations, and gradual extinction cannot be attributed to the operations of an adverse civilization. To many these last considerations will appear to be far-fetched, and to some, not shallow minds, to have no practical bearing; yet it may not, as respects this investigation, be altogether idle in imagination to lose one's self in the continuous woods,

> Where rolls the Oregon, and hears no sound
> Save his own dashings,—for the dead are there;
> And millions in those solitudes, since
> First the flight of years began, have laid them down
> In their last sleep;—the dead reign there alone.

We give this off-hand glance, however, as suggestive of the possibility that the American rate of mortality may be upon a ascending, not a fixed scale, in which a century, if not showing any rapid increase, may yet mark higher notches—the rhythm of the mighty, solemn death march of a people to the tomb—and as prompting the inquiry whether, in event of lessening ratio of population, it may not be due exclusively to depreciating birth-rate, which may be in connection with increasing longevity.

——THE excellent practice of making up a semi-annual statement is continued by the National Life Insurance Company, U.S.A. Such exhibits show good book-keeping, the business closely observed and well in hand; besides, they keep a company fresh before the public, secure a new interest in its career, gain for it a further hearing. We believe that such new publicity, as a general rule, effects increased business. The statement for July 1, 1873, evidences that the National is making decided headway. Its figures are as the trumpet notes of a resurrection to those who, desponding over a present life insurance inertia, have gone in spirit down to the valley of the dead. A supplementary item to the report shows for the year 1873, up to August 1, an issue of 3,073 new policies, insuring $7,117,107—an issue of a greater sum of new insurance in the first seven months of this year than the total of the whole twelve months of 1872. For the first six months $552,363 were added to the assets, bringing the total up to $3,116,275. This shows an asset accumulation on the business of $2,116,275, against aggregate matured liability on the policies, by company's net valuation standard, of $1,862,560.

——WHILE new in his office, Mr. William Selby, superintendent of the Missouri insurance department, has been called upon to prepare the fourth annual report of the bureau, and he submits under date of June 2, 1873, the part of it relating to fire and marine insurance. He goes directly to his work, and presents a fair, though incomplete, generalization of the fire and marine situation of Missouri as respects State companies, but is unable to report the distinctive business done in the State by non-State companies, as the present law requires no such return. He very properly calls for a correction of such deficiency. Without making any attempt to forecast the characteristics of Superintendent Selby's administration, the stages of his advance to the position were not without such hostile comment as will promote circumspection in his official actions, and his initial announcements display a spirit of fairness and equity that inspire the hope that the insurance department of Missouri may yet do real and effective service in the insurance cause. Mr. Selby comprehends the commercial impolicy and economical injustice of a distinctive tax on fire-premium income (Missouri does not tax life premium); he understands that the reinsurance reserve of fire premium is the measure of the company's liability on current risks by its own premium scale (neither more nor less); and while recommending, in accordance with general usage, that Missouri name a certain percentage of premium on undetermined risks as the reinsurance standard, he personally favors the *actual* unearned premium as the reinsurance fund, and in this connection broaches an excellent idea which is the best suggestion that has ever come from an insurance department—viz., *that the reinsurance reserve shall be determined upon the basis of an adequate premium schedule*; that is to say, "if, at the expense, however, of a great deal of labor, books of classification of risks by hazard could be kept, and the reinsurance reserve taken by *uniform minimum percentages of the amounts underwritten*." Mr. Selby does not propose a very easy task for those accustomed to a free and easy hit or miss style of doing business, but he points out the true scientific way in respect to the financial part of fire insurance. The working of the rule we illustrate as follows: If, by any classification of risks and premium adjustment thereto, established by any competent body, say, for example, the National board of fire underwriters, an annual policy for $5,000 on a certain risk calls for $50 premium, the reinsurance reserve on any risk of the same class and amount, *in any company*, having nine months to run, will be three-fourths of the $50, or $37.50. So, whatever the company may be, and whatever may be the terms upon which it is guaranteeing the policy sum in event of fire, for every such policy to run such a period it must show up $37.50—assets admitted only at market value. It is not necessary to expatiate on the value of such a reserve; it would make an end of the greater portion of the swindling which now disgraces the business; carried out, the rascally insurance Cheap Johns would have to take up another trade; it would exact from the fire companies less labor of record and calculation than is exacted from the life companies, and would be worth more for the protection of the public than all the legislation prescribing amount of capital from this to doomsday. Superintendent Selby thinks "it will obviate the necessity for extra reserves." Dissenting from this opinion, we give our views thereon on another page.

The report collates the statistics of the Missouri joint-stock and mutual fire companies for the past four years. There were 21 stock companies transacting business in 1872, and 26 in 1869. The growth of the cash stock capital in four years was as follows: December 31, 1869, twenty-six companies had $2,472,136.63 paid-up capital; 1870, twenty-five companies, $2,757,356.33; 1871, twenty-two companies, $2,848,898.08; 1872, twenty-one companies, $3,190,678.95. At close of 1872 the Missouri fire companies had $100,041,887 at risk, of which $68,739,340 were in Missouri: premiums taken in Missouri, $1,044,999; losses paid, $497,505.00. With $31,302,547 written outside of the State, the outside losses were $799,055.44. For the last four years the existing stock companies show the following aggregates:—

	Assets, Dec. 31.	*Income.*	*Amount at risk, Dec. 31.*	*Average Premium.*	*Per cent. of loss to Premium.*	*Per cent. of exp. to Premium.*
1869……….	$2,425,278	$1,107,895	$26,925,679	1.22	63.5	33.1
1870……….	2,873,642	1,243,717	35,963,370	1.33	54.6	32.8
1871……….	3,488,781	1,496,917	55,016,397	1.43	68.3	32.3
1872……….	4,465,453	2,833,444	100,026,887	1.72	44.1	29.2

MISSOURI JOINT-STOCK FIRE INSURANCE COMPANIES—1872.

	Assets, December 31.	*Income.*	*Amt. at risk, December* 31.
American Central	$544,943 68	$539,035 14	$24,746,737
Boatmen's Insurance and Trust	69,932 53	74,879 65	2,733,663
Citizens'	304,838 71	110,428 22	2,387,389
Commercial	190,127 41	89,389 46	3,214,737
Franklin	132,377 48	55,244 98	1,774,494
German	75,593 14	22,111 35	2,054,044
Home	88,488 07	18,532 62	1,112,449
Jefferson	123,004 39	40,407 10	1,535,732
Lafayette	73,154 42	17,721 52	....
Lumbermens and Mechanics'	236,366 85	41,660 78	663,514
Marine	183,636 11	64,877 17	1,362,735
Merchants'	94,253 05	57,266 34	2,720,605
National	239,038 59	93,547 38	5,261,700
North Missouri	753,678 05	826,472 33	27,208,914
Pacific	65,100 15	63,606 28	953,124
Phœnix	160,297 93	52,341 69	942,251
St. Joseph Fire and Marine	299,704 56	144,665 67	7,731,502
St. Louis	277,070 68	90,046 20	1,548,295
State	346,675 07	256,826 84	9,342,188
United States	205,150 08	128,709 65	1,567,246
Union	102,022 44	45,674 59	1,165,568
Totals	$4,465,453 39	$2,833,444 96	$100,026,887

It will be seen that more than one-half of the business done by Missouri stock companies is transacted by two companies, the North Missouri being at the front. There are 18 Missouri mutual fire insurance companies: these show for the last four years an increase of a little over 6 per cent. of their assets, including premium notes, and 6⅔ per cent. on amount insured, viz.: Total assets, December 31, 1869, $4,681,099; 1872, $4,944,874. Amount at risk, 1869, $78,567,527; 1872, $84,159,386.

——THERE was of late more than the usual clamor about the disputing of death claims by the life insurance companies, and enough to make the new policy acquisitions of 1873 somewhat less than they would have been. Such wordiness all comes from the simple fact that while the paying of a million is done in comparative silence, the resisting of the fraud of a thousand makes a great noise. The Goss-Udderzook case appears, however, to have somewhat enlightened the zealous insurance censors into a faint appreciation that payment of claim with death unproved may be provocative of crime, and that there is a necessity to revise the judgment which has been hastily passed upon the matter of life insurance litigation. For every dollar of claim made there is probably less than two cents resisted, and we have never yet seen any argument from the critics, who suppose themselves qualified to speak on the subject, that such a ratio is disproportioned to the moral conditions of the society in which life insurance operates. As a general rule, the litigating of claims is no more popular with the companies than with the public. It is a profitless work, not worth its cost; but any business man can understand at once that no company can afford to put itself in the position of acceding to every fraudulent demand made upon it. It would be better for the life interest if the policy were, or could be, incontestable, but such a desirable rule is at present not practicable.

In the last five years the life companies of the United States paid about $100,000,000 of claims. We have not the figures of aggregate amount resisted in this period, but the records of almost every company show the ratio of claims resisted to claims paid to be a very insignificant fraction; and the unadmitted demands include such cases as where policies have not been delivered, premium unpaid, death doubtful, &c. A list before us of 34 companies, doing a large part of the business of the country, and each reporting resisted losses, foots up $884,000 as the total in contest by these companies January 1, 1873, and comprises many suits of long standing—possibly not pushed very energetically by the not over-confident plaintiffs. There is no evidence of litigation being a resort of financial weakness; companies with large assets lead the list as to amounts in suit. For example: Mutual Benefit Life, $154,800; Connecticut Mutual Life, $95,500; and we think that any unprejudiced mind, examining fully into the facts of the subject, will be satisfied that the life companies generally do not litigate either from unwillingness to pay or inability to pay.

[Since the foregoing was written we find that we had overlooked a most important tabulation on this subject in the Baltimore Underwriter of August 7. This table is the result of a correspondence with the companies—the requisite blanks being furnished each—and gives the report of their experience from organization to December 31, 1872, of 71 life offices. We append the exhibit as to totals:—

	Number.	*Amount.*
Death losses reported	47,323	$139,376,577
Death losses paid without litigation	46,935	137,625,383
Resisted	388	$1,751,194
Paid after litigation	88	$380,670
Successfully resisted	110	513,232
In suit	190	857,292
	388	$1,751,194]

——HON. LL. BREEZE, secretary of State of Wisconsin, as insurance commissioner, reports amount of fire risks written in the State in 1872, by the 88 authorized companies reporting to his department, as $142,351,376; premiums, $1,910,677; losses paid, $922,637, being .65 per cent. of risks written, against .58 per cent. in 1871, and .80 per cent. in 1870. Losses to premiums in 1872, 48.29 per cent.; 1871, 49.65 per cent.; 1870, 72.44 per cent. The excess of premiums received over losses paid in Wisconsin is $988,040. If 30 per cent. of the aggregate premiums received be deducted for expenses from this amount, the sum of $414,837, or 21.71 per cent. of all the premiums received is left, against $304,753, or 21.22 per cent. for the previous year—showing a net gain of $110,084, or .49 per cent.

Comparative table, showing the fire insurance business in Wisconsin for the past three years.

	Number of companies.	Risks written.	Premiums received.	Losses paid.	Percentage of losses to risks written.	Percentage of losses to premiums received.
1872.						
Wisconsin joint-stock companies	3	$17,530,664	$ 210,433	$ 63,516	.36	30.18
Wisconsin mutual companies	7	25,204,801	366,394	262,983	1.04	71.78
Companies of other States	68	84,478,871	1,129,565	496,392	.59	43.95
Companies of foreign countries	10	15,137,040	204,285	99,746	.60	48.83
Totals	88	$142,351,376	$1,910,677	$922,637	.65	48.29
1871.						
Wisconsin joint-stock companies	3	$14,942,041	$138,753	$ 37,236	.25	26.84
Wisconsin mutual companies	8	21,023,328	272,099	281,023	1.34	103.28
Companies of other States	60	75,054,421	896,219	385,387	.51	43.00
Companies of foreign countries	6	11,064,674	129,126	9,434	.10	7.31
Totals	77	$122,084,464	$1,436,197	$713,080	.58	49.65
1870.						
Wisconsin joint-stock companies	2	$13,450,970	$ 97,961	$ 36,192	.27	36.95
Wisconsin mutual companies	8	28,809,559	339,474	234,096	.81	68.96
Companies of other States	74	100,257,448	1,136,170	868,654	.87	76.45
Companies of foreign countries	4	4,654,978	48,727	36,270	.78	74.44
Totals	88	$147,172,955	$1,622,332	$1,175,212	.80	72.44

Comparative table, giving the mean amonnt at risk, cash premiums received, expenses, losses paid, and the ratio of expenses to premiums, and of losses to premiums and to mean amount at risk, of Wisconsin companies, on December 31, 1872, *for the last five years.*

Number of companies.	Year.	Mean amount at risk.	Cash premiums.	Expenses.	Losses paid.	Percentage of expenses to premiums.	Percentage of losses to premiums.	Percentage of losses to mean amount at risk.
10	1872	$105,163,495	$883,302	$322,787	$534,680	36.54	60.53	.51
11	1871	113,659,436	513,615	217,946	744,538	42.43	144.96	.68
10	1870	114,986,469	437,993	193,241	271,435	44.12	61.97	.24
8	1869	108,704,782	367,626	168,515	217,219	45.84	59.09	.19
8	1868	106,018,129	367,267	198,121	180,135	53.94	90.92	.17
		$548,532,311	$2,569,803	$1,100,610	$1,948,007	42.83	75.80	.36

Total Business of Wisconsin Companies—1872.

COMPANIES.	Net risks in force, Dec. 31, 1871.	Risks written during the year.	Net risks in force, Dec. 31, 1872.	Losses incurred during the year.	PERCENTAGE OF			
					Expenses to		*Losses to*	
					Premiums received.	Cash income.	Mean amt. at risk.	Premiums received.
JOINT-STOCK.								
Brewers Fire In. Co. of Am	$4,259,128	$17,375,686	$14,776,787	$123,505	34.84	31.70	1.36	48.33
Hekla	788,308	1,009,198	1,741,171	2,119	39.55	29.95	.17	15.21
Northwestern National....	4,866,033	24,343,561	7,105,573	85,930	25.42	24.33	2.33	56.76
Totals......................	$9,913,469	$42,728,445	$23,623,531	$211,554	30.59	28.33	1.62	51.38
MUTUAL.								
Concordia......................	$ 993,118	$ 1,151,670	$ 1,920,351	$ 1,601	36.18	33.75	.11	9.50
Dodge County................	12,364,650	3,086,065	11,460,227	33,864	44.10	38.93	.42	91.61
Germantown Farmers'.....	6,594,789	1,953,770	6,685,818	12,322	27.33	24.39	.19	52.85
Herman Farmers'...........	904,728	442,986	1,206,044	1,972	34.32	27.97	.15	35.12
Madison.........................	46,203,646	11,288,677	45,934,025	106,953	60.40	46.12	.27	123.35
Milwaukee Mechanics'....	20,033,668	9,722,887	22,375,080	53,599	40.21	37.74	.35	47.50
Vernon Co. Scandinavian.	50,248	48,955	63,598	10	83.02	56.41	.02	9.43
Totals......................	$87,144,847	$27,695,010	$89,645,143	$210,321	45.38	39.44	.30	74.10

[The Brewers Insurance Company, which commenced in 1869, has a total of $480,547 assets, with a net surplus of $39,351 over its $200,000 cash capital.]

It appears that the assets of the stock companies have increased from $210,395 in 1869, to $871,825 in 1872. The aggregate assets of the mutual companies have decreased within the period named from $2,553,117 to $1 855,235; shrinkage, however, limited altogether to premium notes. German Mutual, of Milwaukee, withdrew from business in 1872.

The fourth annual fire and marine report of Mr. Breeze is a good one, and shows progress in State insurance registration. He well says:—

Much, it is true, has been done within the past two or three years to secure uniform statements; still it is equally true that there is much yet to be accomplished. This can only be brought about by the coöperation of the State officials having charge of the subject, and of the companies themselves. True statements rendered upon uniform blanks, bringing thereby the companies in their methods and management under proper and uniform tests, will do much, not only to simplify the duties of supervising officers, but also to secure soundness of organization and proper management.

——THE full contents of the Massachusetts insurance commissioner's eighteenth annual report, part I, (fire and marine insurance), will embrace 600 pages. We have received at this writing only the introduction to the same (88 pages). In this Commissioner Clarke discusses governmental supervision, the Boston fires of November, 1872, and May, 1873, recent legislation, judicial decisions, and gives some historic notes in connection with present review of the British companies whose home offices Mr. Clarke lately visited for the purpose of personal investigation. The new data contained in the introduction being very limited, we defer any selections from the report until the receipt of the more strictly statistical portions. We take occasion, however, to remark, while on this topic, that as circumstances have rendered the affairs of the Liverpool and London and Globe Insurance Company the subject of much ill-informed comment, Mr. Clarke made the examinations of this company peculiarly searching and comprehensive with the aid of professional experts; a preliminary scrutiny of data and documents covering 15 or 16 years of the company's business preceding inquiry into all points of present controversy. The amount of assets subject to this examination was $21,250,000 (accounts of 1871).

The liabilities of the company were closely scrutinized and computed, with the exception of those pertaining to its life and annuity department. For the latter, Mr. Clarke was quite willing to accept the computations of Mr. Augustus Hendriks, one of the most experienced, competent, and *reliable* actuaries in England. It may be a matter of interest to many Americans to know that, under his direction, the non-participating policies of the Liverpool and London and Globe are valued by the Carlisle tables, with interest at 3 per cent.; its participating policies by the same mortality tables, with interest at 4 per cent.; and its life annuity policies also by the same tables, with interest at 3½ per cent. The Globe policies, which are kept distinct, are valued by the Northampton table, with interest at 3 per cent. The liability under the latter, January 1, 1872, was £485,110.

The aggregate liabilities (accounts of 1871), as shown in the examination, amounted to nearly $17,000,000, leaving a surplus of nearly $4,300,000 as regards policyholders. The item of liability particularly investigated in this, as in other cases, was the reinsurance fund. Under the system of returns so exactingly enforced, the books of the company show at all times the nearest possible results of its business through agencies at home and abroad. These accounts were, therefore, a test in that behalf, and, in determining the reinsurance liability, strict regard was had to the character and terms of outstanding risks. At the beginning of the present year, as shown by the company's annual statement, it was in possession of assets amounting in the aggregate to nearly $21,190,000, with liabilities amounting to $17,640,000, leaving a surplus of $3,550,000. Its premium receipts on fire business in 1872 were very nearly $6,300,000—a million in excess of its reported and supposed losses. The total premium receipts of the company from its organization have been upwards of $60,000,000, out of which it has paid losses amounting to nearly $42,000,000.

——WE have received bound volumes II and III of the Coast Review, a monthly quarto, published in San Francisco by Messrs. Riley & Edwards, as an exponent of the insurance and mining interests of the Pacific coast, and it well fills its functions in both departments. As an insurance journal the Coast Review shows vim, force, and an industrious and close watch over all insurance movements. We were favorably impressed, some time since, with a thoughtful presentation in its columns of the topic, Why is the Insurance Business Disreputable? If its truth was not flattering, its intuitions and judgments respecting practices to be reformed altogether were most sound. We can also commend its notes of current events, though part of one of such notes in its August issue is a little too much for us. That paragraph says the daughter of the editor of the American Exchange and Review was lately married, at which news the editor aforesaid confesses himself astonished, not being himself aware of the impossible occurrence.

——FOR the election of a new directory of the St. Louis Mutual Life Insurance Company, July 31, there was, as we have stated, a heated canvass, and this culminated in a balloting of a very excited character, with the spirit of faction rather rampant—clique battling against clique, after the fashion of a political contest. There was, however, this merit in the strife: it was proof that there was an earnest interest felt in the result, and this is preferable to the listless indifference with which insurance administrations are frequently continued or changed. The fight, however, was largely upon individuals. There were four tickets in the field—the State Agents' ticket, the McLean (anti-Peck, anti-old-board) ticket, the Peck ticket, and the ticket of ultimate mixture. The general agents were on the ground in full force, and armed with proxies to the teeth. The State Agents' ticket had on it six names of the McLean side, as a compromise, as well as nominees of the Peck ticket; but the patent-medicine death-against-Peck faction (McLean) set up a distinctive anti-Peck ticket. The vote nearly exhausted the list. Of 15,320 entitled votes, 13,623 voted, viz.: Of 1,000 shares of stock (each one vote), 909 shares were voted; of 14,320 policy-holders, 12,191 voted by proxy, and 523 in person. After the election a protest was served upon the judges, from McLean and others, against the receipt of proxies dated the day of election, holding that "no one except the signer of the proxy has the right to date the same."

After the lapse of three weeks the result was announced, as the election of the following gentlemen: W. J. Lewis, Geo. P. Plant, R. P. Hanenkamp, J. T. Donovan, John G. Priest, C. S. Rogers, W. F. Boyle, P. S. Pfouts, J. G. Woerner, H. D. Mackay, L. L. Ashbrook, Theodore Bartholow, James E. Yeatman, William T. Selby, Ira W. Malin, J. G. Brown, N. Schaeffer, D. K. Ferguson, J. F. Thornton, J. P. Krieger, H. T. Simon.

With two exceptions, the successful nominees were candidates of the State Agents' combination; Messrs. Malin and Donovan, however, running on both the Peck and the McLean ticket, defeated Messrs. George R. Robinson and Jacob Tamm, distinctive nominees of the State agents. Messrs. Priest, Pfouts, Selby, Schaeffer, Ferguson, and Thornton were on the Peck ticket; and Messrs. Plant, Rogers, Boyle, Woerner, Bartholow, and Krieger were on the McLean ticket. The election of the others may be regarded as the special triumph of the agents—most conspicuous in their success with Mr. H. D. Mackay. Messrs. Lewis, Ashbrook, Hanenkamp, Selby, Brown, Schaeffer, Ferguson, and Thornton were members of the previous board. At the organization of the new board of directors, August 22, Mr. W. J. Lewis was unanimously elected president of the St. Louis Mutual Life.

——MR. CHARLES H. STOKES, president of the Penn Fire Insurance Company of Philadelphia, died August 19th. Mr. Stokes was born February 3, 1840, and his death at the early age of 33 years cuts short a life of promise, and removes from the underwriting circle one who filled in it an honorable place, and whose character and ability were pledges of greater prominence. He had the confidence of the business community—a confidence won by faithfully fulfilling various duties. He was a resident of Germantown, and held a position in the Germantown Mutual Insurance Company for 13 years, and was called from this company to the presidency of the Penn upon the organization of the latter company. He will be long remembered in Germantown as one of its most useful and public-spirited citizens. In addition to the presidency of the Penn Fire, he was also president of the Germantown Transfer Company. At a meeting of the directory of the Penn Fire, August 23, the following preamble and resolutions were adopted:—

> WHEREAS, The afflicting hand of Providence has been heavily laid upon us in the decease of our late president Charles H. Stokes:
>
> *Resolved*, That we desire to express our profound sorrow for this bereavement, and our deep sense of the loss inflicted by his demise. As an officer he was industrious and faithful, guarding the manifold interests of the company with consciencious vigilance; as a friend he was firm and true; as a husband and father, kind, devoted, and indulgent; as a citizen, pure and noble.
>
> *Resolved*, That we extend to his stricken family our earnest sympathy in this sudden grief, trusting the kind Father will temper and assuage their sorrow.

——MESSRS. DUY & WOODS, Philadelphia, resign the Pennsylvania agency of the Knickerbocker Life Insurance Company of New York, leaving the affairs of the company in the State in a very satisfactory condition. The Pennsylvania premiums of the Knickerbocker now amount to about $150,000 per annum—nearly one-half of which was the acquisition of the company during the Pennsylvania management of this firm.

——It is certainly not by many words that the remarkable Ohio insurance superintendent makes his sensations. His sixth annural report, part II, (life insurance), is as short, curt, uncompromising, and decisive as compressed language can make it. He opens with a fling at the 260 pages of abstract statements which make up the bulk of his octavo volume, characterizing the companies' returns as things "that *purport* to be a correct exhibit of their financial condition." With submission to the court, we suggest that, like Hamlet, Mr. Church should

Know not seems.

The Ohio law requires that if he have "good reason" to suspect the correctness of any annual statement, that he shall prove its truth or falsity by an examination into the company's condition. If the statements are mere representations, not verities, they are not rightly in his report. Next and immediately, inter-State insurance comity gets a dab—the receipt of other State department valuations of life policies being degraded to a *dependence* of Ohio "upon other State officials for information." The pleasant song sung for the last few years of State reciprocity has its melody disturbed by a call for a law making requisite an Ohio calculation of the reserve of every life company doing business in the State. Such individual State valuations make life insurance a good thing—for the actuaries and the rest; costing the life interest say $20,000 for each State exacting a fee of one cent on every thousand dollars insured, and $60,000 where the fee is three cents—more than half a million for the whole country—and all for the purpose of piling up the like eternal heap of computations, reaching substantially the same result. This recommendation comes, too, when Ohio has just joined hands with the majority of the other States in a 4½ per cent. interest standard.

Another project, designed to check amalgamation rascalities, is commendable. Plan: withdrawing company to give three months' notice of purpose to reinsure to its policyholders and the State insurance department, informing the latter of the terms and conditions upon which the proposed transfer of risks is to be made.

Ohio has two life insurance companies—or rather has one—and another, the Toledo Mutual Life, started late in 1872, and issuing 43 policies in the balance of the year. Among the 1872 examinations of the superintendent was that of the Union Central Life, of Cincinnati. He credits this company with a surplus of $61,824.13 over its $734,471.63 of liabilities. We give two extracts from the report: 1st. "Examinations were made in November of the National Life, and Protection Life, of Chicago, Illinois, which indicated both were financially *unsound*." 2d. "Said companies having since filed their annual statements, have received from the superintendent certificates of compliance and authority to transact business as heretofore."

The returns, in some instances incomplete, show the following as—

THE LIFE BUSINESS DONE IN OHIO.

	New Policies, 1872.	*Amount insured thereon.*	*Policies in force Dec. 31, '72.*	*Amount insured thereon.*	*Premium, 1872.*	*Losses paid, 1872.*
Ohio companies.........	2,588	$4,998,924	4,118	$5,967,016	$438,688	$65,919
Other-State companies..	12,726	25,188,123	55,925	135,958,394	4,504,571	1,415,619
Total................	15,314	$30,187,047	60,043	$141,925,410	$4,943,269	$1,481,538

——COMMISSIONER FORSTER, of Pennsylvania, is interviewing the insurance companies of the State, under the section of the department law demanding an examination of their affairs. It will be understood that the Pennsylvania law simply or substantially requires but conformity to charter, and a reinsurance reserve according to the official standard. In respect to such companies the condition of part of them is publicly known; of others no such public knowledge exists. An adequate disclosure with respect to the latter is what is looked for from the commissioner.

——THE Guardian Mutual Life Insurance Company of New York withdrew from Massachusetts for the simple reason that, as a business enterprise, it promised no satisfactory results. No report was therefore made to the Massachusetts department for 1872.

——No further developments in the Goss-Udderzook matter have been made public since our previous issue. It is notable that there is not a single circumstance fixing the identity of the remains found in the Chester county (Pa.) wood as being other than those of W. S. Goss. It is not incumbent upon the Goss side to prove who was murdered if not Goss, but it is certainly very significant that there appears to be no answer to the question: If "A. C. Wilson" was not Goss, who was he? The trial of Udderzook has been postponed by the West Chester court to October He has been arraigned on two counts: 1st, the murder of Winfield S. Goss; 2d, the murder of an unknown man.

——One Shepherd was much drowned, July 19th, in four feet of Potomac water, below Alexandria. This sad event parted the two gentle Shepherds—George and Joseph—George being the submerged unfortunate. Policies on George's life amount to $7,000, which Joseph carries. Joseph arrested; also a boy, James Green, who rowed George Shepherd to the spot off Jones's Point, where his earthly lot terminated. Are not some of the present life insurance solicitors bringing in a precious party of valuable applicants? Such abuses will inevitably force, before the time, the establishment of the incontestable life policy as a bar to the acceptance of such risks.

——Mr. Stephen English, publisher of the Insurance Times, is out of Ludlow Street jail, bail having justly been reduced to $8,000. Now "let us have peace." Peace not only in this quarter, but let us have an end of the senseless and damaging squabbles which are disgracing the life interest. Conceited individuals, thinking it necessary to air their own personal importance, keep fuming and bubbling, and have contrived to distract attention from really essential matters. If those who sincerely wish to serve the life economy would leave such disturbers severely alone, the bubbles would soon burst. Life insurance is a work, not a farcical fight.

——We note with pleasure that the Insurance Company of North America and the Franklin, of Philadelphia, coöperate with the statistical work of the National board committee in collecting the general insurance experience of the last three years on certain classes of risks, thereby setting a good example to such offices, large and small, as yet hesitate to show up.

——D. H. Kline, of Erie, Pa., has accepted the position of general superintendent of agencies for C. E. Rollins, Philadelphia. Mr. Kline has had a large experience in this line, having been engaged with the Ætna, under Mr. Bennett's western management, and also with Mr. Downing, of Erie. He was also late manager of western department of the German, of Erie.

——The old Hartford again emerges from the flame pressure with a semi-annual 5 per cent. dividend. The Ætna offsets an assessment of 40 per cent. on new stock, with a dividend of 20 per cent. on the old stock. Ætna, Hartford, and Phœnix are the three Hartford fire companies whose stock is selling above par.

——The Spectator says: "The agency of the Security Life, of New York, for eastern Ohio and western Virginia, has been removed from Bellaire to Steubenville, Ohio, where, under the careful management of Mr. H. M. Hickok, the company's affairs are in a flourishing condition."

——Connecticut General Life Insurance Company reduces its capital from $500,000 to $125,000.

——Mr. George Adlard, an old and respected underwriter of New York, died August 15th. He introduced the Queen Insurance Company into the United States, and gave it an American prestige. He had previously been American manager of the Unity Fire, of London, and closed the American business of the Unity with credit.

——Though some new life insurance company may in the future burst into a sudden, unexpected, and brilliant success, the present outlook over the life field indicates that the life business of the country in the near coming years will be transacted by about thirty of the present offices.

——The New England Insurance Gazette—whose items of insurance intelligence we have generally found to be correct—asserts that the risks of the late Hercules Life, of New York, were reinsured in the New Jersey Life—erst the Hope Mutual Life.

——Hartford fire companies put up their rate on paper mills from 1½ to 2 per cent.—an advance of 45 cents on the National board tariff—the mills having outburned the National board measure. How about said National board being a mere combination to extort high rates?

——An act of the State of New York, regulating the responsibility of the agents of insurance companies (State or other-State companies), approved June 10, 1873, defines the legal status of an agent who converts the company's money to his own use—he is a thief.

——J. M. Forster, insurance commissioner of Pennsylvania, is of the opinion that the Alps, of Erie, will, *with prudent management*, be able to pay all its losses, and *perhaps* save sufficient capital to start on a new basis.

——The New York Life Insurance Company transacted last year the largest business done in Ohio by any life company. In former years the Connecticut Mutual was at the head; it is now ninth on the list as respects new business.

——At a late meeting of the board of directors of the Newtown Insurance Company, of Bucks county, Pa., a resolution was adopted to increase the capital from $100,000 to $250,000.

——In Canada, in 1872, 72.7 per cent. of the fire premium of all the companies—American, English, and local—was required for the losses paid, against 67.3 per cent. in 1871.

——There is a growing appreciation of the necessity of the three-quarter clause, and its insertion in policies of northern and western fire insurance companies is beginning.

——The Norwich Provident Fire Insurance Company, of Norwich, England, will open an American branch. Mr. J. J. Berne, New York manager.

——The Commercial, of New York, and the Williamsburg City Fire Insurance Company are each paying semi-annual dividend of 5 per cent.

——Late sales of New York fire insurance stocks Metropolitan, 70 per cent. of par; Lamar, 79; Niagara 95; Lenox, 95½; Firemen's, 99.

——Another Southern life insurance company withdraws—the Carolina Life, of Memphis, Tenn.—Jefferson Davis, president—this time "consolidating."

——Mr. H. Prindle has been appointed manager of the Eastern and Southern department of the Atlantic and Pacific Insurance Company of Chicago.

——Mr. Francis Robinson is trustee in liquidation of the Anchor Life, appointed by the board of trustees under the New Jersey law.

——Nine companies at present run the plate-glass insurance business of England.

RAILWAYS AND TRANSPORTATION.

THE annual meeting of the stockholders of the Erie Railway Company having been changed from October to July, on the 8th of the latter month the first regular meeting under the new regulations took place. There were six vacancies in the board of directors, caused by the resignations of John G. Cisco, J. V. L. Pruyn, A. S. Diven, Charles Day, and Governor Dix, and the decease of G. T. Oliphant. The following is the new board of directors for 1873–4, which was elected without opposition: Samuel D. Babcock, George H. Brown, Herman Baltzer, Samuel L. M. Barlow, W. Butler Duncan, Giles Hotchkiss, Wm. T. Hart, Adrian Iselin, John Taylor Johnston, Henry L. Lansing, Edwin D. Morgan, Cortland Parker, Homer Ramsdell, Lucius Robinson, Frederick Schuchardt, Wm. W. Shippen, and Peter H. Watson. The principal part of the voting seems to have been done by Mr. S. L. M. Barlow, who presented himself with about $60,000,000 of proxies—nearly one-third of which were denied a vote, there being no time to count them.

The election being closed, an address was read from President Watson of the following import: After saying that the report was far from complete, even for the current six months, the president remarked, that the earnings of the road during the past half year largely exceeded those for any similar period since its completion. The reforms begun have diminished the expenses in almost every department, and when the present plans for double track and narrow gauge shall have been carried into effect, there is no reason why the road cannot be operated as cheaply as any other trunk road. Business facilities are being rapidly increased, twenty miles of sidings and ten miles of second track having been laid, arrangements made to reduce the heaviest grades on the line, and a considerable increase in rolling stock having been obtained—the advantages of all of which are already beginning to be apparent. The president also thinks that the proximity of the road to the coal-fields of Pennsylvania and Ohio will far more than counterbalance advantages possessed by other lines. The funded debt of the company has been increased during the year by the addition of $10,000,000 of convertible bonds, of which $8,000,000 have been sold at par in currency, and the remainder will probably be placed at the same rate as soon as the money is needed. Assuming the whole amount to be placed, this makes the funded debt at present $40,040,140. The capital stock remains unchanged; common, $78,000,000; preferred, $8,536,910—total, $86,536,010. The floating debt, as reported July 1st, 1872, was $6,463,668.20. The present floating debt is only about $1,700,000, showing a reduction in one year of upwards $4,750,000. In February last, in addition to the regular dividend of 7 per cent. on preferred stock, a dividend of 1¾ per cent. on the common stock was declased; "and subsequently," adds the president, "although the circumstances attending the paying of this dividend were carefully scanned by a committee of the legislature, nothing was discovered then or since to raise a doubt that the dividends were actually and legitimately earned, and properly declared and paid." President Watson also announced as his policy and that of the present board of directors of carrying the cost paid from earnings of all additions to the property and equipment of the road to capital account, taking care in all cases to make ample allowance for the necessary expenditures for a full and liberal reparation of the road and machinery in every department, and then dividing the net earnings among the stockholders at short intervals—say semi-annually. Upwards of 40 miles of grading for double track will be ready for the rails in September; and 80 miles more will be finished the present year. During this year, also, the present gauge of the road will be changed from Attica to Painted Post, a distance of 100 miles, and a third rail laid from Attica to Buffalo, and from Painted Post to Waverly, which will give a narrow-gauge connection (4 feet 8½ inches) with Philaphia and the anthracite coal-fields.

President Watson is unquestionably a sanguine official; but, unless he can induce capitalists to see the future of the Erie with his eyes, the question arises, how can the necessary funds be raised to accomplish all that seems indispensable before the road can hope to compete on anything like equal terms with the gigantic corporations on each side. There are rumors of various proposed combinations between the Erie company and the Atlantic and Great Western, the New York and New England, and the New York, Boston and Montreal companies; and the fact that William H. Brown, one of the new Erie directors, is president of the New York, Boston and Montreal, and another director, William T. Hart, is president of the Boston, Hartford and Erie company, gives color to the supposition, though precisely what combinations are to be formed, and the extent thereof, no one seems to know. The unprecedented, and—from a Bear stand-point—outrageous action of paying a dividend on the common stock, has so disturbed the market and rings that law-suits are threatened for the purpose of ousting the present board of directors, and restoring a board which, whatever may have been its shortcoming, never ventured so far from the paths of rectitude as to attempt the like. On the whole, president Watson, although he seems supported by the greater part of the stockholders, and most of the New York dailies, will find it no easy task to reconcile opposing interests and lift the road to a level with the other great corporations, which is his present object.

——A REPORT of the operations of the Missouri, Kansas and Texas railroad, lately published, shows the amount of business transacted by that company during the year ending March 31, 1873. The roads owned by the company at the date of the report extend from Sedalia, Missouri, *via* Parsons, Kansas, to Denison, Texas, 432½ miles; from Parsons, north-west, to Junction City, Kansas, 156½ miles; and from Holden, Missouri, to Paola, Kansas, 54 miles—making a total of 643 miles. The average mileage during the year was about 586 miles. Another extension, 53 miles in length, has been completed from Sedalia, north-east, to Moberly, and the company has secured control of the Hannibal and Central Missouri road from Moberly to Hannibal, 70 miles in length, since the date of the report. From the non-completion of the Houston and Texas Central road, until just before the report, the company was deprived of through connections with Galveston until the last moment, which undoubtedly materially affected the receipts of the road.

The earnings from all sources for the year were $3,955 per mile.........	$2,317,568
The expenses were 59.41 per cent..	1,376,907
Leaving net earnings $1,608 per mile.......................................	940,661

This shows a very large increase over the previous year; but no accurate comparison can be made, owing to the unfinished condition of the road now and then. The capital stock of the company is $16,945,000, and the funded debt $16,596,000—making the total fixed capital account $33,541,000—about $48,191 per mile. The land-grant to the company amounted to 4,465,142 acres, of which there have been sold 271,271 acres for $1,709,572, an average of $6.30 per acre.

——A CASE of considerable importance to carriers of passengers, growing out of the murder of Avery D. Putnam by a drunken passenger, has been lately decided by the Supreme court of New York at a general term, whither the case was carried by the defendant company, on appeal from the court below. The Broadway and Seventh Avenue Railroad Company was sued by the relatives of the murdered man for damages. The railway company claimed in defence, among other things, that as Mr. Putnam had only one foot on the car at the time he was struck his journey was ended, and the responsibility of the company, if any had been, had ceased. This plea was held by the court as entitled to no weight, and the broad ground enunciated that a railway company was not only not obliged to carry drunken and dangerous passengers, but was obliged to expel such from the car, and protect the passengers from insult. It would be better if conductors generally understood this doctrine, and applied it faithfully.

——WHILE the general business and net incomes of most of the railroads in the country are advancing, we notice some exceptions. Thus, in addition to the passing of its usual dividend by the Michigan Central, adverted to elsewhere, we notice the Northern railroad of New Hampshire, which extends from Concord, N. H., to White River junction, 69 miles, with a fixed capital account of $3,170,500, or $38,430 per mile, shows a decrease in gross earnings of 2¼ per cent., an increase in expenses of 5⅝ per cent., which, together, have resulted in a decrease in net earnings of 14¼ per cent. as compared with the previous year. And the Central Railroad Company of Iowa has issued a circular to the bondholders respecting the non-payment of interest. This circular is to the effect that the earnings of last year were less than the cost of operating, and that the floating debt is now about $950,000, of which $524,000 is for money advanced to pay interest. The amount of the first mortgage bonds is $3,700,000, and the second mortgage is $925,000. The interest due last April on the second mortgage bonds remains unpaid, and there seems to be no funds with which to pay the July interest on the first mortgage. In addition to this want of money to pay the interest, the road is running down in point of equipment, and its usefulness much impaired by the want of 31 miles of new road. In order to obtain means for building this new line and equipping the road the bondholders are asked to deposit their coupons for the next two years' interest with the Farmers' Loan and Trust Company, of New York, and receive in return scrip bearing interest at 7 per cent. gold, and running until January 1, 1874. When the interest shall be thus funded the company proposes to issue preferred stock, to take up the floating debt, and raise money for the necessary work and equipment. The suggestion is said to be favorably received by the bondholders.

——WE are in receipt of an official statement of the assessment of railroad property in Indiana, as made by the State board of equalization, dated July 31, 1873. It includes the assessed value of the main track, side track, and rolling stock of each road in the several counties, and the superstructures and improvements on the right of way. The personal property of the various companies, and the land lots and improvements belonging to them not on the right of way, seem not to be included. We can only give the sum total as follows:—

Total mileage—main lines	3,557.49
" side track	423.09
Aggregate	3,980.58
Assessed value—main lines and side tracks	$38,726,954.00
Average per mile	9,728.62
Assessed value of rolling stock	9,079,036.00

We observe that the Pittsburgh, Fort Wayne and Chicago road enjoys the proud distinction of being assessed the highest of any—$17,000 per mile for main line; the Michigan Central and Michigan Southern rating next, at $16,000 per mile; while, if we mistake not, the Lafayette, Muncy and Bloomington road enjoys the solid advantage of being assessed at the lowest rate—$1,000 per mile. Only 9 out of the 93 counties have no railroad property within their limits.

——IT is yet too early to determine what will be the result of the discussion on railroads in the Pennsylvania Constitutional Convention; but that body, while displaying much more enlarged views than have been taken in the West, shows a desire to control the railway companies in matters which certainly ought to be left to the sound judgment of those who are responsible to the shareholders. No law, whether organic or otherwise, can ever compel men to build and operate railways at a loss. No body of railway managers are so short-sighted as to cripple trade or impoverish he country along the line of their road, and they can safely be trusted to regulate matters of freight and passenger charges in their own way. Ex-Governor Curtin stated the whole difficulty in a few words when he said that if any attempt was made to equalize freights, they would be equalized up nstead of down, and must be so equalized to avoid ruining the companies. That is precisely what has been done in Illinois; and while no one, especially the promoters of the equal freight fantasy in that State are benefited, it is now conceded by those who are the most capable of judging ntelligently, that the interference is workingly disastrously to the best interests of the State at lar

——Under the name of the Chicago Railway Transfer and Clearing House, a joint-stock company, with a capital of $500,000, has been organized for the purpose of transferring freight cars through Chicago. As the business is now carried on, the through cars are said to be detained on an average from five to seven days, and are damaged more by reason of the crowded state of tracks and consequent rough usage, than they are in an average run of a thousand miles. The new company proposes to effect the transfer cheaply and expeditiously by constructing a road outside the city limits quite around that part of the city not bounded by the lake, thus intersecting every railroad that now enters the city, or any that may hereafter be built. At these intersections ample sidings, &c., will be built, and the company proposes to transfer every car to its proper line, whether loading in the city or arriving from other points, the same day. The length of the proposed railroad, including 10 miles of sidings, will be about 30 miles, and it is estimated that it can be built and equipped with the necessary rolling stock and telegraph for $450,000. Taking these figures as a basis, an enterprising Chicago editor figures out, much to his own satisfaction, a net profit of $150,000 per annum. Without vouching for these prospective profits, the scheme certainly seems worthy of a careful examination. If freight is delayed in Chicago to the extent claimed, any plan by which its speedy transfer can be effected is worthy of the support, not only of the transportation companies, but the business public; and, when 30 per cent. net profit is promised, it becomes too good to be believed in.

——Some time ago St. Louis made "resolves" that another railroad to the Pacific was necessary, and one was wanted which could be controlled by St. Louis capital, or at least that would not be controlled by rival interests. The finale of the matter was the commencement of a railroad which was to be constructed on the 35th parallel from St. Louis to the Pacific, to be called the Atlantic and Pacific road. The construction of this line has been pushed with commendable energy, and it is now finished to a place called Vinita, in the Indian country. At a meeting of the shareholders and managers in New York, August 9th, Col. T. A. Scott was elected president, and President Thompson was also elected a director of this corporation. This is thought to indicate a speedy consolidation of the Atlantic and Pacific and the Texas Pacific under one management at least, and probably the abandonment of the construction of one of the lines for the present.

——According to lately published statistics for 1872, the 117 railroads in Pennsylvania have a mileage of 4,179 miles on the main line, with 1,618 miles of double track, and 1,784 miles of sidings. The bridges number 2,623, of which 481 are iron, 1,774 wood, and 368 stone. There are 51 tunnels. The total capital stock paid in, $439,864,345.82; the funded debt, $325,413,597.66. The total expense of operating and maintaining these roads and machinery was $86,295,900, and the total earnings were $134,818,848.92. The total cost of the roads and equipments was $524,395,133.45; this includes real estate, exclusive of road-bed, to the value of $22,257,832. There were killed during the year 572 persons, and 988 injured, of whom in each case but a small percentage were passengers.

——President Joy, of the Michigan Central railroad, is out in a circular explaining the proposed passing of the next semi-annual dividend. His explanation is simply that the company find that the pending improvements are likely to cost more than was anticipated, and all the proposed loan will be exhausted; and while the company have earned the dividend and got the money, the directors think that the interests of the company will be promoted by using the money in improvements, instead of dividing it among the stockholders, and then immediately going into the market and replacing it by borrowing at ruinous rates. This seems logical and above-board, the more as a detailed report is promised in a few days showing the financial standing of the company.

——The New Orleans and St. Louis Trans-Atlantic Steamship Barge and Wharf Warehouse Company is the imposing title of a company which proposes to accomplish a much-needed work in New Orleans—nothing less than building a wharf in water deep enough to float the largest ships for the accommodation of all the ocean steamship lines, 1,000 feet in front, and securing proper ground contiguous thereto, and constructing a union depot. Four large batture squares in New Orleans, with all right of batture and accretion, have been purchased, and the work will be pushed vigorously forward.

PATENTS, ARTS, AND SCIENCE.

[This Department is under the editorial charge of WILLIAM H. WAHL, Ph. D.]

THE iron market shows no improvement from the depression noted for July, and prices are still working downward, and rule very irregularly. Quotations are rather nominal than actual. Several lots of No. 1 Lehigh were offered at $38, and no buyers at the offering. The market is well stocked with all grades. Orders for manufactured irons come in slowly. The Pittsburgh mills are furnishing bar at 3¼c. Latest advices from abroad indicate yet lower prices for Scotch pig. Total shipments for July, 44,882 tons, against 73,182 tons for same month last year. Direct shipments to Philadelphia, 1,351 tons. There is considerable demand for rails from the companies on twelve months time, accepted in some cases, and prices are a little firmer than the general market. We hear of two or three small corporations trying to exchange bonds for rails.

August Iron Report.

	2d.	9th.	16th.	23d.
AMERICAN FOUNDRY PIG:—				
No. 1	$42.00	$42.00	$41.00	$41.00
No. 2	38.00	38.00	38.00	38.00
" (plain)	36.00	36.00	35.50	35.50
No. 3 (gray forge)	33.00	33.00	33.00	32.00
No. 4 (mottled)	30.00	30.00	30.00	30.00
White	28.00	28.00	28.00	28.00
SCOTCH PIG:—				
Gartsherrie	48.19	47.94	47.79	47.10
Coltness	49.60	49.34	49.19	48.64
Summerlee	48.19	47.94	47.79	47.10
Langloan	48.19	47.94	47.79	47.52
Calder	48.48	47.94	47.79	47.52
Carnbroe	46.78	46.54	46.12	48.54
Glengarnock	47.63	46.96	46.40	46.12
Eglinton	46.50	45.71	45.55	45.00
Dalmellington	46.50	45.71	45.27	45.28
Old rails, D.H.'s	49.00	49.00	48.00	48.00
" T's	48.00	48.00	47.00	47.00
No. 1 Wrought scrap	44.00	43.00	42.00	41.00
Cast scrap (machinery)	35.00	35.00	35.00	35.00
Stove-plate scrap	30.00	30.00	30.00	30.00
Wrought turnings	35.00	35.00	35.00	35.00
Cast "	25.00	25.00	25.00	25.00
American refined bar	3$\frac{5}{16}$c.	3$\frac{5}{16}$c.	3$\frac{5}{16}$c.	3·$\frac{5}{16}$c
" common bar	77.00	77.00	77.00	77.00
" rails	77.00	77.00	77.00	77.00
English rails (ex. ship.)	77.72	77.72	77.72	77.72
Railroad spikes	......	......	......	......
Nails (℘ keg)	4.25	4.25	4.25	4.25
Street rails (deliv'd on car, Broad & Willow)	77.00	77.00	77.00	77.00

We cite, as an addendum to the foregoing, the following evidence from Iron (London) of the ability of the American maker to come to the conditions of the market under any pressure of competition:—

"The experience of the past and present year demonstrates that when iron exceeds a certain price, the foreign demand upon which the prosperity of our [the English] iron trade depends almost entirely ceases. Four months ago we showed that Staffordshire bars at £14 10s. per ton could not possibly compete with Pennsylvania bars in the market of New York, as the native produce could be sold at £2 9s. per ton lower than imported bars. The almost entire cessation of American orders since that date proves clearly the soundness of our deductions. Competitors have taken the place of customers; America undersells us in the Canadian market. The recent reduction of £2 per ton in finished iron has completely failed to infuse any vitality into the English iron trade, and, in the words of 'A Merchant,' 'at least another £2 must come off before we can look for any revival.' Present stagnation is only part—and a very small part—of the evil. Trade once diverted into a new channel will be long before it resumes its ancient course, and there is already ground for apprehension that the American market is lost to us. Ironmasters declare that at the present price of fuel it is not worth while to manufacture iron."

——IVORY, it is well known, is the osseous matter of the tusks and teeth of a variety of land and marine animals, among which are the wild boar and hippopotamus. In composition it is about 66 per cent. phosphate of lime with hard cartilage, a little carbonate of lime, fluoride of calcium, &c. The ivory of the walrus is covered with a fine compact enamel, attributed to the proportion of fluorine which it contains. The texture of this variety takes a higher polish than that of the elephant, is the toughest and most translucent, and was much employed before porcelain was used in the manufacture of artificial teeth. The tusk of the East India elephant is of a finer texture than that of the African, and less liable to crack. Ivory chips, turnings, and sawdust are always carefully preserved for making a fine size, or for ivory black. The former (says Prof. Wetherbee, in Journal of Applied Chemistry,) is made by boiling in water, and is sometimes used for forming a fine, hard surface upon cardboard, &c., and the latter by calcining the ivory in the same manner as is employed with bones in the manufacture of bone black. The ivory dust may also be ignited in a covered crucible when only small quantities are wanted. It is considered the finest material for copper-plate printing, being of a very rich, velvety black. It is too expensive, however, for any but the finest work, and much of the so-called "ivory black" is prepared from bones. A cheaper material than ivory, which would afford a finer black than common bones, might be prepared from the teeth alone of slaughtered animals, if manufacturers would only take the trouble to extract them and calcine them separately. It is sometimes desirable to render ivory flexible and plastic, so that it may be made to assume any desirable form. This is accomplished by immersing it in dilute phosphoric acid of a specific gravity of 1.130 until it becomes semi-transparent, and when washed and dried with a soft cloth it becomes as flexible as leather. When exposed to dry air it gradually becomes hard, but may again be made soft by immersing it in hot water. Many articles of use, like children's nursing bottles, are made in this manner. Fine engraving is sometimes done upon ivory by a sharp instrument in the same manner as upon the metals, but etching is performed in the following manner: A "ground" or varnish is applied to the polished surface, made of asphalt one part, white wax and gum mastic each two parts, melted together. The figure is then traced through the varnish in the usual way, and the exposed lines etched by applying any solvent or decomposing agent, as sulphuric or hydrochloric acid. If desired to make the etched lines black, an acid solution of nitrate of silver may be used, or if purple an acid solution of gold. The varnish may then be removed by spirits of turpentine. A very old recipe for silvering ivory directs it to be placed in a neutral solution of nitrate of silver, and exposed to the strong rays of the sun for three hours the surface of the ivory, after drying, to be rubbed with flannel until a bright metallic lustre is produced.

Articles of ivory are dyed any desired color; the polish is usually given after dyeing, as when the surface is comparatively rough it absorbs the solution better than after the pores are filled in the polishing process. Any shade of red may be given by first immersing the ivory in a solution of nitro-muriate of tin, or tin mordant, and then in a bath of Brazil wood or cochineal. For scarlet, lac dye is used, and for cherry red, after the bath of lac dye, one of a solution of potash is employed. Yellow is produced by the tin mordant, followed by a hot bath of decoction of fustic. A more permanent and finer yellow is given by steeping the ivory twenty-four hours in a strong solution of chromate of potash, and then for the same length of time in a hot solution of acetate of lead. Ivory is dyed blue of various shades by a bath of sulphate of indigo, to which carbonate of potash is added to neutralize the acid. By dipping the blue ivory first in a solution of mordant, and then in the above-named fustic solution, a green color is produced. Violet is given by first giving the ivory a bath of tin mordant, and then one of logwood. This may be changed to a purple red by adding a few drops of nitro-muriatic acid to water and immersing the violet ivory for an hour. Black is produced by nitrate of silver, or, what is much better, by first boiling in a decoction of logwood, and then immersing for some time in a solution of acetate of iron.

In the search of a good substitute for genuine ivory, the following combination seems to be the only one which has thus far proved successful, viz.: Two pounds of pure India-rubber are dissolved in thirty-two pounds of chloroform, and the solution saturated with purified ammoniacal gas. The chloroform is then evaporated or distilled off at a temperature of 185° F. The residue is mixed with pulverized phosphate of lime or carbonate of zinc, pressed into moulds, and cooled. When the phosphate of lime is used, the resulting compound partakes in a greater degree of the composition of genuine ivory, and the India-rubber takes the place of the cartilage.

——THE introduction and operation of coal-cutting machines in various coal-fields is at present one of the most notable incidents of the coal interest. That recently brought out by Messrs. Hurd & Simpson (an English invention) is described as being adapted to almost any workable seam of coal. The machines, which only require a space of three feet from the props to the fall of the coal, are constructed to work seams from 18 inches thick and upwards, and are said to be the result of ten years' study on the part of the designer. The machine consists of a cutting wheel armed with cutters, which are made of plain steel, square set sideways above and below, for the clearance of disc, and adjustable radially according to kind of cutting. The cutters, which are put into or taken out of cut by a swivel, nut and screw acting on the lever in which the cutters revolve, may be driven by an ordinary bevel pinion, or by a double pinion with bevel teeth, and a recess to embrace the inner centre ring; and the friction is resisted by conical anti-friction bowls, thus dispensing with guides and slides. The machine is supported on a bogey frame, which is mounted on carrier wheels to the footstep of the shaft, the fulcrum on which swivels the radial arm, to which is connected the cutting wheel; but the frame can be swiveled around independent of the radial arm. Plow shoes, which can be fixed on either side of the machine, are provided, to prevent or remove the debris from the cutters from lodging on the rails in front of the wheels. The special part of the invention, however, consists in the eccentric action of the cutters and the differential lever for adjusting the machine to the inequalities of the face of the coal. By placing the stocks eccentric to the fulcrum on which the cutters revolve, the cutting hold is secured, and a considerable saving is effected in the power required. By the combination of a differential lever with a leading bowl and the hauling chain, a self-acting adjustment is secured to the inequalities of the coal, which enables the machine to work on an ordinary tramway, or where there is a tolerably straight floor without a tramway. The machine is also described as being self-acting in adjusting itself in its forward motion to the variable hardness of the material being cut. The machines have several other peculiarities which require too elaborate a description to be suitable for abstraction.

In the same connection we give an account of the recent trial of the first practical coal-cutting machine in the United States. The machine is employed in the Coal Brook mines of Messrs. Niblock, Zimmerman & Alexander, situated about 2½ miles north-east of Brazil, Indiana, and is known Brown's Monitor coal-cutter. The machine consists of a 5 horse-power steam engine, driven by steam carried into the mine by a steam pipe, terminating, however, in a few feet of rubber hose, which permit of full freedom of motion to the machine. The intention of the proprietors is to employ compressed air in place of steam as soon as their experimental trials are finished. The cutting arrangement is an irom rim of 4 feet in diameter, which has on its periphery movable steel teeth, placed at points about 12 inches apart. These teeth may be taken out and ground whenever they become dull. This rim lies on small wheels which support it and allow a free motion, and has cogs on its under surface which gear into cogs on a shaft turned by the engine. By this means the power is applied near the circumference of the wheel, instead of at the centre, as in the ordinary circular saw. The principal reason for this arrangement is to get a deeper cut at the coal. The cutter can be put to a depth of 3½ feet or seven-eighths of its whole diameter, whereas the ordinary circular saw can scarcely cut to one-half of its diameter. The machine runs on a movable track, and is fed by means of a screw working in cogs. The track is put down along the side of the coal at the proper distance from it, and, when a cut has been made the whole length, the machine is put on tracks and wheeled to the next room, where the track is laid as before, and so on through the mine. The duty of the machine is put down at about a yard in five minutes. The estimate of its economy given by the proprietors is, that it saves about 35 cents per ton over the cost of putting out coal by hand labor, which, in a mine turning out say 200 tons a day, amounts to a saving of $70 per day. The first cost of the machine in addition is very moderate, being only about $800.

——THE forty-third annual meeting of the British Association for the Advancement of Science will convene at Bradford on Wednesday, the 17th of September, on which day the first general meeting will be held at 8 P.M., when the president will deliver an address. The concluding meeting will be held on Wednesday, the 24th of September, at 2.30 P.M., when the association will adjourn to meet the following year at some place to be fixed upon. At two evening meetings, which will take place at 8.30 P.M., discourses on certain branches of science will be delivered. There will also be other evening meetings, at which opportunity will be given for general conversation amongst the members.

The following is a list of the presidents and vice-presidents and officers of the association as well as of the various sections and departments: President elect, James Prescott Joule, Esq., D.C.L., LL.D., F.R.S.; vice-presidents elect, Earl of Rosse, F.R.S., F.R.A.S.; Lord Houghton, D.C.L., F.R.S.; Mr. W. E. Forster, M.P.; the Mayor of Bradford; Mr. J. P. Gassiott, D.C.L., F.R.S.; Professor Phillips, D.C.L., F.R.S.; Mr. John Hawkshaw, F.R.S., F.G.S.: local secretaries for the meeting at Bradford, the Rev. J. R. Campbell, D.D., Mr. R. Goddard, Mr. Piele Thompson: local treasurer for the meeting at Bradford, Mr. Alfred Harris, Jr.: general secretaries, Captain Douglas Galton, C.B., R.E.; F.R.S., F.G.S.; Doctor Michael Foster, F.R.S., Trinity college, Cambridge: assistant general secretary, Mr. George Griffiths, M.A.: general treasurer, William Spottiswoode, M.A., LL.D., F.R.S., F.R.G.S.: auditors, Mr. John Ball, F.R.S.; Mr. J. Gwyn Jeffreys, F.R.S.; Col. Lane Fox, F.G.S. The sections are the following: *A.* Mathematical and Physical Science.—President, Professor Henry J. Stephen Smith, LL.D., F.R.S.; vice-presidents, Professor Balfour Stuart and Professor Henrici; secretaries, Professor W. K. Clifford, M.A., J. W. Glaisher, Professor A. S. Herschell, and Professor Forbes. *B.* Chemical Science.—President, Dr. W. J. Russell, F.R.S.; vice-presidents, Professor Roscoe and I. Lowthian Bell; secretaries, W. Chandler Roberts, F.C.S., Dr. Armstrong, and Professor Thorpe. *C.* Geology.—President, Professor Phillips, D.C.L.; vice-presidents, W. Pengelly; secretaries, Louis C. Miall, William Topley, F.G.S., R. Tiddeman. *D.* Biology.—Vice-presidents, Dr. Beddoe and Professor Rutherford, M.D. Department of Zoology and Botany.—Secretaries, Professor Thiselton-Dyer and Professor Lawson. Department of Anatomy and Physiology.—Secretaries, E. Ray Lankester and Dr. Pye-Smith. Department of Anthropology.—Secretaries, E. W. Rudder, F.G.S., and J. H. Lamprey. *E.* Geography.—President, Sir Rutherford Alcock; vice-presidents, Major-General Sir Henry Rawlinson and John Ball; secretaries, H. W. Bates, F.L.S., F.R.G.S., Keith Johnson, F.R.G.S., and Clements R. Markham, C.B. *F.* Economic Science and Statistics.—President. W. E. Forster, M.P.; vice-presidents, Dr. Farre, Lord Houghton, D.C.L., E. Baines, M.P.; secretary, J. G. Fitch, M.A. *G.* Mechanical Science.—President, W. Froude, LL.D.; vice-president, A. Bessemer; secretaries, H. M. Brunel, J. N. Shoolbred, H. Bauerman.

The American Association will hold its twenty-second annual meeting in the city of Portland, Maine, commencing Wednesday, August 26th. The officers of the meeting are: President, Joseph Lovering, of Cambridge, Mass.; vice-president, A. H. Worthen, of Springfield, Ill.; general secretary, C. A. White, of Iowa City, Iowa; treasurer, William S. Vaux, of Philadelphia; permanent secretary, F. W. Putnam, of Salem, Mass.; standing committee, J. Lawrence Smith, o

Louisville, Ky.; Alexander Winchell, of Syracuse, N. Y.; E. S. Morse, of Salem, Mass.; together with the officers of this meeting already named. The local committee, to judge from the circular, is doing all in its power to further the convenience, comfort, and entertainment of the visitors; and the meeting of this year promises to be quite equal in interest, and fully up in attendance, to any of its predecessors.

——THE employment of artificial means to produce great cold has in many branches of industry grown to be an absolute necessity, and a number of plans have for some years been in use to accomplish this object. Quite recently some inventors have struck upon what seems to be the simplest and at the same time most efficient method of securing this desideratum, namely, by the expansion of compressed air. The Windhausen ice-making and refrigerating machine is the most elaborate development of this plan, and has often been of late referred to as one of the most successful in its operation. The invention is based upon the well-known principle of pneumatics, that a compression of the atmosphere produces heat, and its subsequent expansion cold. For the purposes of his invention Windhausen employs, either a single double acting cylinder, or two distinct cylinders, the double acting cylinder being capable of compressing the air on the one side of the piston and of expanding it on the other; whilst, when two cylinders are employed, one is used for compressing the air, and the other for expanding it afterwards. The air is first admitted into the compression chambers, where, being compressed, it then passes into one or more condensers, which form a material part of the invention. These condensers consist, by preference, of one or more cylindrical chambers, having a parallel series of pipes in each, through which the condensed air passes; a stream of water being constantly directed in an opposite course to the current of compressed air, so as to cool the air passing through the pipes. The air having made the circuit of this series of pipes, and a portion of its heat created by the compression having been extracted by the action of the running water, it then enters the expansion cylinder, where it is expanded and cooled, and thence escapes into the space to be refrigerated, or is brought into contact with the liquid to be frozen or cooled. The condensed air, after the cooling it receives, flows into the expansion cylinder, there to resume its normal volume. The expansion here takes place slowly, under a gradually diminishing pressure regulated by valves operated by the expansive force of the air itself. Having parted with nearly all the heat produced by compression before expansion, when the air thus reduced is expanded again to its normal volume, this action abstracts the same quantity of heat as was taken from the body of air by the water currents; and as this can only be in part furnished by surrounding objects, a very intense degree of cold is produced by the abstraction of heat from its own supply, and this diminution of temperature is manifested at the very first opetion of the machine. Machines on this principle have been constructed competent to expand and deliver in one hour 150,000 cubic feet of air per hour, and it is stated at a temperature of from 30° to 35° below zero, Fahrenheit. The freedom of this form of machine from all the inconveniences attendant upon the employment of chemical substances, which form the basis of many of the ice-machines in use, is a great point in its favor, and machines constructed upon this principle cannot fail in time to supplant all others.

——MR. JOHN C. TRAUTWINE, the well-known civil engineer, recently communicated to the Franklin Institute the following item of interest relative to the fracture of cast iron pier cylinders: "It is not perhaps generally known to the profession that cast iron cylinders, composed of sections bolted together through inside horizontal flanges, and filled with concrete, as is usual when employing them for bridge piers, &c., have, in several instances in the United States, split or cracked asunder entirely around the circumference, under the influence of extreme cold weather. The reason of this, I presume, is, that the outer and more exposed cylinder tends to contract to a greater degree than the inside and more sheltered concrete, and that the hold which the inside flanges have upon the solidified concrete in which they are embedded prevents the contraction from taking place without rupture of the cylinder. Unless suitable means be applied to prevent this, the efficiency of such cylinders may be much impaired. It has been suggested that an inside lining of vertical wooden staves, projecting inwards as far as the flanges do, will be an effective remedy. Other methods will, no doubt, present themselves. My object is simply to give greater publicity to an important fact."

——A NEW miner's safety lamp has recently been invented by H. D. Plimsoll, for which it is claimed that it gives a light superior to that afforded by the old form of lamp, and is at the same time perfectly secure against explosion. Its operation is stated to be that, when fire-damp enters the lamp, a small detonation takes place inside the lamp, which at once extinguishes it before the explosion can extend to the outside of the lamp. In pure air the lamp gives a bright light, but damp diminishes its brilliancy After the lamp is once lighted it is impossible to get access to the light without extinguishing it. The lamp would, therefore, appear to fulfil all the conditions which are to be expected of such an apparatus; and careful experiments with it, conducted by miners of long experience, are said to have completely substantiated its value. The following is a description of its construction, which, it will be seen, is extremely simple: At the bottom of the lamp is an air-chamber shaped like the fustrum of a cone, the upper end of which closely surrounds the wick, so that no air or gas can enter the lamp without coming into contact with the flame. The bottom of this air-chamber is protected by a plate of metal pierced with very small openings. The oil receptacle is in the centre of this air-chamber, and the space between the two is only ⅛ of an inch wide, so that, as the inventor claims, no explosive flame can pass through it. The result of this construction is, that should fire-damp pass through the openings in the metallic plate, it comes into direct contact with the flame and extinguishes the lamp. The only possible danger which can be conceived from its use would be from the burning gases escaping by the openings through which the fire-damp entered the lamp, but this is rendered impossible, because the flame would be extinguished in the air-chamber through the small size of the passages.

The inventor has another attachment to his lamp, with the aid of which he claims that it would be feasible to enter the most dangerous mines. He connects the air-chamber of the lamp by means of a rubber tube with a bag, or other reservoir of pure air, which supplies the lamp. With this arrangement he claims the lamp will burn in an atmosphere where the workmen would be obliged to be supplied with a helmet and tube communicating with the outer air.

The chief advantages claimed for it are as follows: 1st. It is very sensitive to the presence of fire-damp. 2d. As soon as the explosion occurs the light is extinguished, and the lamp cannot therefore become red-hot. 3d. The flame cannot be tampered with by the miner, because by unscrewing the cylinder the light is put out.

——THE administration of the government of the Netherlands has published the results of some experiments upon the preservation of sheet iron used in railroad bridges. Of thirty-two sheets half were cleaned by immersion for twenty-four hours in diluted hydrochloric acid; this was then neutralized by treatment with milk of lime, washed with hot water, and while warm dried and rubbed with oil. The other half was only cleaned mechanically by scratching and brushing. Four of each kind were then equally painted with red lead and with two kinds of a red paint of oxide of iron and with coal tar. The plates were then exposed to the weather and examined after three years' exposure. The result was: 1. That the red lead had kept perfectly on both kinds of plates, so that it was impossible to say if the chemical cleaning had been of any advantage. 2. That one kind of iron oxide red paint gave better results on the chemically treated plate than on the other; in fact a result equal to that of the plate painted with red lead, while the other kind of iron oxide red gave not very good results on the plates, which were only scratched and brushed. 3. That the coal tar was considerably worse than the paint, and had entirely disappeared from those iron sheets which had not been treated chemically, but only cleaned by brushing.

——IT is stated that the expenses of the Vienna Exposition are 8,000 florins per day, requiring 16,000 paying visitors each day on the average, which number do not attend. There is a daily deficit of at least 1,500 florins; all brought about by inadequate arrangements for provisioning the city and sheltering the sojourners. In other words, a great additional multitude was left to be provided for by the existing means and ordinary sources of supply, and the result was that the strangers were, as respects prices of living and other necessaries, at the mercy of limited circles of dealers.

——A METHOD of illumination which has been quite largely adopted by steamship companies—the Cunard, the Inman, the Pacific, and others—is that of F. M. Silber. This system will not be able to displace gas lighting where such is available, but seems to be adapted for the wants of steamships, railway cars, &c. It is said, in addition, that nearly all the English railway companies have introduced the Silber lamp, both for signal lamps and for lighting the coupés. The material employed in the lamp is oil, which is converted by a peculiar construction into gas before its combustion. The peculiar operation of the lamp avoids the burning of the wick and the collection of impurities upon it, as well as evolution of smoke. These desiderata are accomplished by converting the oil into gas, not at the flame, but before it arrives there, and by regulating the combustion in such a manner that a constant supply of gas and air in fixed proportion shall be furnished. The wick of these lamps remains almost entirely free from charring, and one of them will last, it is said, about a year. To keep it in burning order it is only necessary to wipe the wick off daily. The light is very steady, white color, and though very bright, yet mild and pleasant. The burners are made of various sizes to meet the needs of consumers. Concerning the intensity of the light afforded by the lamp it is represented that a burner of 1¼'' diameter affords a light equivalent to 28 standard candles; while a burner of 1¾'' diameter is equivalent to 50 such candles—an illuminating power which,it must be confessed, is unprecedentedly good.

——IN Canada, American railway iron is delivered at prices 15 to 20 per cent. below that of Staffordshire. The statistics of the Canadian trade and navigation for year ending June 30, 1872, make the following exhibit of values of the classes of imports named into the four old provinces of Canada, viz.:—

Articles.	*From United States.*	*From all other countries.*
Cutlery	$64,624	$214,869
Britannia and metal ware	19,034	6,657
Spades, shovels, hoes, etc.	50,773	29,640
Spikes, nails, &c	41,544	71,205
Stoves and other castings	149,735	121,249
Other hardware	1,293,568	1,727,049
Total	$1,695,278	$2,200,669

By this it appears that at the middle of last year we had already acquired 42 per cent. of the hardware trade of Canada, and the peculiar embarrassments surrounding the English iron industry since that time will no doubt have operated to make the showing for this year still more favorable for American iron men.

——THE employment of phosphor-bronze for useful purposes in the mechanic arts seems to be slowly extending, though in the construction of ordinance it has not proved to be as successful as was expected. In France it has been employed by a large concern ever since its first production, three years ago, for the bearings of plate and general rolling mills. The engine that drives the rolling mills in which it is used is about 200 horse power, and the speed of the rollers about 60 revolutions per minute. The rollers are 6.23 feet long, and 2.03 feet in diameter, and weigh 5 tons. It was found that the gears, made of hard cast iron, broke frequently; these were first replaced by ordinary bronze, then by phosphor-bronze. The life of the ordinary bronze wheels did not exceed, on an average, five months, while those made of phosphor-bronze were about nine months. When applied to bearings the latter alloy is found equally superior to the former. Phosphor-bronze has also been applied with great success, not only in the making of pinions, but in the driving axles of mills.

——MESSRS. VAN GUNDEN & YOUNG, of Philadelphia, have a national reputation for the excellence of their ornamental marble-work used in cemeteries, gardens, &c. Orders for such designs in marble are received from a majority of the States. This firm also imports statuary and marble ornaments executed from their own models, which are of high artistic merit. Their Scotch granite shafts are especially admired. At the principal yard and warerooms 45 men are employed. We notice this establishment as one of rising merit, and one that contributes its share to advancing the standard of Philadelphia workmanship.

——ARMY boots and shoes, having the soles screwed to the uppers by means of brass screws, are being manufactured in Philadelphia—between 600 and 700 pairs are turned out each day—the work almost wholly performed by machinery run by steam. The uppers having been cut out by hand, are screwed together by machinery, and the soles are pressed into shape by an iron mould and steam power. The two are slightly attached by hand, and are then taken to the brass screw-machine, which is about the size of an ordinary lathe, and is controlled by a single workman. The shoe is put upon a movable arm of steel, and is placed under the upper gearing, to which a long brass wire ⅛-inch in diameter is fed. By one movement, and with extraordinary rapidity, a thread is cut upon the brass wire, and the screw thus made is forced through the sole and uppers, and is rivetted on the inside under a pressure of 1,700 pounds upon the steel arm upon which the shoe was placed. Just as the operation is completed, the screw is cut from the rod close to the sole, and the operator repeats the action until the shoe is studded with brass screws from toe to heel. The ends of the wires are cut off by two rapidly revolving discs, and they are then filed down to a level with the sole. The heels are cut off by machinery, and have the holes punched in them for the nails at one motion. The nails are put in the holes by boys, and then by one movement the heels are securely fastened to the shoe by the machine. The heels are burnished by means of a burnisher, heated by gas and operated by machinery. The edges of the soles are burnished by hand, and the soles are then sand-papered and finished by machine work. The whole operation is exceedingly rapid.

——THE history of coal gas is attended with some strange incidents, which indicate very clearly that for the application of a scientific fact to practical purposes everything must be ready for the innovation, else it will be useless to attempt to force its introduction. The inflammability of gas obtained from coal was a fact well known long before the idea was entertained of turning it to practical use. The miners in the coal regions of Europe were long familiar with the inflammable qualities of the fire-damp, and very correctly attributed it to the gaseous exhalations of the mines. As early as the latter part of the seventeenth century Dr. Clayton actually made coal gas, and described its properties very correctly. He distilled coal in a retort, and—to use his own words—the result was "phlegm, black oil," and a spirit which he was unable to condense, but which he confined in a bladder. These products would now be designated respectively as water, tar, and illuminating gas. Clayton several times repeated the experiment, and used to amuse his friends by burning the gas as it came from the bladder through holes which he pricked in it with a pin. It is plain that the hint here so palpably given of the inflammability and luminosity of coal gas did not suggest to any minds of the time the practicability of applying it for the purposes of illumination until many years afterward.

——FROM French sources it is stated that M. Chevallier, a French engineer, has adopted, with successful results, the use of cork for the jacketing of steam-boilers and other parts of machinery. Cork is known to be an excellent non-conductor of heat, and these jackets are said to diminish the outward loss by radiation from 15° C. The cork is cut in the form of staves, and these are united together by tongues, as in the case of flooring boards, so that the lines of junction are protected while the cork staves are easily removed when necessity demands their removal. Portions of one of these jackets which had been on a boiler at work for 15 months were exhibited some days since at a meeting of the Paris Society for the Encouragement of the Arts, &c., and were found to be entirely unaffected by the heat of the boiler.

——WE learn from Prof. Henry Wurtz, of New York, editor of the American Gas Light Journal, of the formation of a national association of the gas fraternity of this country. The name of this body will be "The Gas Light Association of the United States." The want of such a union of the talent engaged in the gas manufacture throughout the country, in order to further this important industry in its commercial and scientific relations, has long been felt; but until this last movement which inaugurated it, all efforts in that direction have been unsuccessful. It will doubtless prove exceedingly beneficial, as have those established in foreign countries. The officers of the new association are: Chas. Roome, president; P. E. Demill, W. H. Price, and Thos. R. Brown, vice-presidents; Prof. Henry Wurtz, secretary; and J. W. Smith, treasurer.

——It is proposed by the Delaware, Lackawanna, and Western railroad, to build a second tunnel, owing to some inconveniences attendant upon the great business at present conducted in the Bergen tunnel. The estimates for the work have been handed in, and are now under consideration by the managers of the road. The work is to be pushed forward very rapidly, and it is announced will be completed within 21 months after the contract is signed. The entrance to the new tunnel will be 1,300 feet north of the entrance to the Erie tunnel. From this point it will extend in an almost straight line for a distance of 4,200 feet, being from the opening to Oakland avenue 1,500 feet, from this avenue to Bergen Wood avenue 1,200 feet, and thence to the terminus, 1,700 feet. It will be 75 feet in height and 35 feet in width, thus affording ample room for two tracks. In order to give light to the tunnel it will be furnished with a central opening of 300 feet, and with 6 other shafts. At the west side of the hill the tracks will cross the Erie road at an elevation of 35 feet. To accomplish this the grade will be changed, and a new bridge of heavy masonry will be built across the Hackensack river. The material required for this construction will be furnished by the tunnel excavations. On the completion of the tunnel a ferry, for the exclusive use of the passengers of the road, will be established. The cost of the whole work will reach about $1,500,000.

——The design of the centennial buildings submitted to the centennial commission by the distinguished Philadelphia architect, Samuel Sloan, proposes a structure of 2,200 feet in length from east to west, with a general width throughout, not including that of main building, of 500 feet, exclusive of a picture gallery (500 by 200 feet, 40 feet high) at east end of main building, and about 200 feet from it, and connected by a covered way. Main central building of iron, stone, and brick, 600 by 350 feet, surmounted by a dome 100 feet in diameter and 310 feet high, crowned by a statue of America. The main building is designed to be permanent, and to inclose the memorial hall, or national art museum, when the centennial building shall have fulfilled its purpose. East and west of the permanent building extend ten pavilions, five on each side, each having a distinct entrance and a cupola rising from the centre of each pavilion, forming a series of domes; each of these pavilion sections 45 feet high from the floor to the springing of the centre arch of its roof. These sectional pavilions can be removed without damage to the material, and preserved as a memorial. The various details of interior arrangement, ornamentation, and appointments, can be given to the reader only by a description too long for our pages. Mr. Sloan is now preparing a plan for the final decision of the commission.

——Accepting statements made as true, the Paris gas company, though a monopoly, gives to that city the best light in the world. Its supply is furnished through more than a thousand miles of pipe, and the company pays to the city $40,000 annually for the right. It bears the cost of repairs whenever pipes have to be relaid, pays more than $500,000 annually for taxes, and nearly three times as much as the city's share of its profits, besides the pay of 750 lamplighters, who light and extinguish the lamps over a space of 950 miles in 40 minutes.

——By allowing a few drops of chloride of sulphur to act upon 30 grammes of aniline—the mixture being continually stirred—M. Hamell has produced a new dyestuff of a red color, which in ten minutes becomes solid. This body dissolves in acetic acid with a red color, and, on evaporating this solution to dryness, a black, glistening mass is obtained. Like most of the aniline colors it dissolves in alcohol, ether, and acetic acid.——New quarries of lithographic stone have quite recently been found in Italy, near the French frontier, and on the coast of the gulf of Genoa, from which, it is said, that a stone of excellent quality has been obtained. This discovery is of great importance, since of late years the supply of this stone, obtained mainly from German sources, has been gradually diminishing.——To produce a collodion film of extraordinary tenacity, which may be desired for certain purposes, Böttger recommends that the collodion cotton be dissolved in a mixture of ether and alcohol in equal volumes, and that a small quantity of balsam of copaiba be added. When spread upon glass, it leaves, according to the chemist named, a membrane of extraordinary firmness.

MONETARY.

It may be said that the whole financial situation at present is strictly normal, attended with nothing not characteristic of the season. The usual manipulation of gold in New York, which precedes the September scarcity of the coin, is culminating, and the clique has been successful in duping more than the usual number of venturers "to go short." A large part, however, of those who are short of gold seem to have fortified themselves either with time loans of gold or by borrowed sterling. Sterling exchange is approaching the specie importing point, its weakness in part accounted for by the anxiety for time gold as a source of profit in the enhanced value of cash gold. The stock exchanges are languid, the mercantile demand for money light, the manufacturing interest somewhat depressed, and the banks show decreasing loanable resources.

In accordance with the new mint law, Germany will for the future have the following new money pieces, which will go into general use on the first of January next: Gold—a 20-mark piece, equal to 6 reichsthaler and 20 groschen, or 2,000 pence; a 10-mark piece, equal to 3 reichsthaler and 10 groschen, or 1,000 pence. Silver—a 5-mark piece, equal to 1 reichsthaler and 20 groschen, or 500 pence; a 2 mark piece, equal to 20 groschen, or 200 pence; a 1-mark piece, equal to 10 groschen, or 100 pence; a ½-mark piece, equal to 5 groschen, or 50 pence; a ⅕-mark piece, equal 2 groschen, or 20 pence. Nickel—a 1/10-mark piece, equal to 1 groschen, or 10 pence; a 1/20-mark piece, equal to ½ groschen, or 5 pence. Copper—a 1/50-mark piece, equal to ⅕ groschen, or 2 pence; a 1/100-mark piece, equal to 1/10 groschen, or 1 penny.

——*Sales of Stocks, etc., at New York.*

	Aug. 4.	Aug. 11.	Aug. 18.	Aug. 25.
U. S. 6's, coupon, 1881	119½	120⅜	119¾	119½
" 5-20's, coupon, 1862	117	117½	117	117
" 5-20's, coupon, 1864	117¼	117⅝	117¼	117¼
" 5-20's, coupon, 1865, m & n	118¼	119¼	118¾	118¾
" 5-20's, coupon, 1865, j & jy	117⅛	117⅝	117⅜	117⅛
" 5-20's, coupon, 1867	118½	119½	119¼	119
" 5-20's, coupon, 1868	118	118⅜	118⅛	118
" 10-40's, coupon,	115¼	115⅝	115⅝	116
Pacific 6's, currency	....	113⅛	113¼	113⅝
Tennessee 6's	81½	82	82	82¼
" 6's, new	81⅛	81¾	81⅞	82
North Carolina 6's	27	27	27½	27½
" 6's, new	16	....	15	15½
Missouri 6's	93	92⅞	92½	92
N. Y. Central and Hudson R. con	105⅜	105½	104¾	104⅜
Harlem	133	....	131½	130⅜
Erie	59⅝	59⅛	59¼	59⅛
Lake Shore and Michigan Southern	94¾	94⅛	93½	92⅝
Wabash	72½	71¾	70⅛	69½
Cleveland and Pittsburgh	89	....	87¼	87⅛
Northwestern	68⅝	68	64⅞	64
" preferred	83¼	83¾	82¾	81¾
Rock Island	110⅜	110⅝	109¾	108⅝
Fort Wayne	....	....	93⅞	....
Milwaukee and St. Paul	53⅜	52¾	51⅝	51
" " preferred	73¾	73⅝	71	70
Ohio and Mississippi	39⅝	40¼	38½	39¼

	Aug. 4.	Aug. 11.	Aug. 18.	Aug. 25.
New Jersey Central	103	103	102½	....
Western Union Telegraph	92½	92⅜	90⅜	90
Pacific Mail	38	40⅜	40	44¼
Union Pacific	28⅜	28⅜	27⅛	26¼
Adams Express	....	94¼	94½	93
Wells, Fargo & Co. Express	74	74	73	73
American Merchants Union Express	....	....	62	62⅝
United States Express	....	66¼	66	67
Rate for Money	3@3½	5	3½@4	4@5

Sales of Stocks, etc., at Philadelphia.

	Aug. 4.	Aug. 11.	Aug. 18.	Aug. 25.
Gold	115⅜	115⅜	115½	115¾
Sterling Exchange	125⅝	125⅝	125¼	124¾
Paris Exchange	4.56	4.56	4.57	4.55
Lehigh Valley Railroad	61⅛	61⅛	61	61
" " 6's	....	95	95	95
" " 7's, reg	104	105	104½	101
Lehigh Navigation	38⅝	38½	38⅛	37⅜
" " 6's, 1884	90¼	90⅝	....	90
" " 6's, g ln	90¾	91	91½	91½
" " 6's, reg	91½	92	92	92½
City 6's, no tax	101⅜	101½	101⅜	101½
" tax	98	98¼	98¼	98¾
Pennsylvania Railroad	54⅜	54⅜	54⅜	53¾
" " allot	54¼	54	54	....
" " 6's, 1 m	100	100	100	100¼
" " 6's, 2 m	100	100½	100¼	100½
Pennsylvania 6's, first series	....	100	....	100
" 6's, second series	102	103	103	103
" 6's, third series	106⅝	108½	108	108⅜
Reading Railroad	55½	55½	55⅜	54⅞
" " 6's, mt	95	95	96	96
" " 7's, reg	102½	102½	102¾	102½
Catawissa Railroad	19	19	19	19
" " preferred	42⅝	42¾	42	42⅝
North Pennsylvania Railroad	49	49¼	49½	49½
" " " 6's, mt	....	99	99½	99½
" " " 7's, mt	101½	101½	101½	101½
" " " 10's, chat	110	110	110	110
United N. J. Companies	123	123	123¾	122¼
Camden and Amboy 6's, mt	96½	96¾	96	96¾
" " 6's, 1883	....	90	90	90
" " 6's, 1889	88	88	88½	88½
West Jersey Railroad 6's	94	94	94	94
" " 7's	....	....	....	102½
Philadelphia and Erie	24⅜	24	24	24
" " 6's	89¾	90	90½	90
Allegheny County 5's, coupon	....	75	....	78
Schuylkill Navigation	....	6	6	6
" " preferred	12	12¼	12⅛	12
" " 6's, 1882	....	71	....	71
Morris Canal	....	....	48	48
" preferred	....	....	120	120
" 6's, 1882	94	93	94	94
Little Schuylkill Railroad	46⅜	46⅜	46⅜	46
Oil Creek and Allegheny Railroad	26½	25½	25	23
" " " 7's	71⅞	71	71	....
Philada., Germ. and Nor. Railroad	87	87	87	86½
Minehill Railroad	51½	51½	52	52
Elmira and Williamsport, preferred	38	38	38	38
" " 7's	95	94	94	94
" " 5's	58	58	58	57
Northern Central	36½	36	36⅛	....
Rate for Money	5	5	5@6	5

NOTING AND COMMENTING.

POLITICAL affairs in Spain maintain their three-sided character. A severe engagement took place late in July between the government forces and the Carlists, near Pampeluna, in which the latter were successful, capturing 300 prisoners and a large quantity of arms and munitions. The Carlists have received material aid from their friends in England—the notorious yacht Deerhound having succeeded in landing at Fontarabia, near Bilboa, 3,000 Remington rifles, a large quantity of ammunition, and 40 Carlists; all of which were received by a detachment of 600 Carlists and safely conveyed to the interior. The vessel was not so fortunate, being subsequently captured by a Spanish man-of-war, and is still detained; while the government is deliberating whether to treat the master and crew as prisoners of war or pirates, with a strong inclination towards the latter course. The Carlist force in Spain is reported to be 26,000 men, and at this time there seems some reason for supposing that Don Carlos is gaining ground; though the report that Berga had been captured by his forces, after a stubborn resistance, is denied. The independent cantonists seem, on the contrary, to have been almost entirely unsuccessful in their operations. They, under the leadership of General Contreras, seized several men-of-war at Cartagena, and succeeded in getting away with some of them; and attempted to capture Almeria, in which, however, they were unsuccessful. Contreras subsequently attempted to proceed to Madrid at the head of 300 or 400 men, expecting a demonstration in his favor, but was disappointed, and his command routed by the government forces—himself narrowly escaping capture. He was, however, seized at Malaga by a German man-of-war, and held as a hostage for the good behavior of his friends, who are in possession of several iron-clads, and are amusing themselves by attempting to extort money from the respectable inhabitants of the various Spanish seaports and threatening death to all foreign consuls and residents, but has since been released. The government forces have succeeded in retaking Seville and Valencia from the insurgents, and also, it is believed, Cartagena—though the last item needs confirmation. Much feeling is manifested by the republican government of Spain at the present attitude of the French authorities in their leaning towards Don Carlos. Complications are also threatening between the Spanish government and those of England, France, and Germany; from the refusal of the last to restore to Spain the gun-boats captured from the insurgents, and with the former two from the seizure of the Deerhound—the French authorities alleging that the seizure was made in French waters. Altogether, there is certainly no diminution of the perils surrounding the republic.

A message from President MacMahon, prorogueing the French assembly, was read before that body, July 29th, and after approving the treaties of commerce between France and England, and resolving that the permanent committee of the assembly shall sit once in two weeks during the recess, the assembly adjourned. Rumors were immediately circulated that the president would resign after six months and resume the command of the army, as it was desirable that he should be in that very position when the time came for another *coup*. Within a few days after the adjournment of the assembly, one hundred deputies united in an address to the pope, assuring him of their continued devotion, and at the same time, the Count de Paris, being suddenly seized with fraternal feelings, started to pay the Count de Chambord a visit at Frohsdorff, stopping on his way at Vienna, where he was received by the emperor. These things, taken in conjunction, have induced quite an excitement among the republicans; and the members of the left and the extreme left are actively caucassing and planning the overthrow of their opponents. Meanwhile, the government has not been idle, and has demonstrated the trite maxim that "possession is nine points in the law," by sending its agents to the different provinces to manufacture public opinion, and putting down with a strong hand about twenty republican newspapers.—An enthusiastic squad of legitimists have offered the crown of France to the Count de Chambord, and he has been graciously pleased to accept the same, and has further announced that he will rule by the will of God and the good will of the French people.—Henri Rochefort, after examination and being declared able to bear the fatigue of the voyage, has been shipped to New Caledonia.

England just now, for want of something more startling, is disposed to get disturbed over the approaching royal marriage of the Duke of Edinburgh to the Duchess Maria, of Russia. As usual, in such cases, her majesty asked for a grant of an allowance for a marriage portion. An animated debate was had in parliament over the proposition, and several telling speeches were made against it, but in the end it prevailed by a large majority.—Parliament was prorogued August 5th by the usual speech of indefinite generalizations from the throne.

The Dominion of Canada discusses a railroad investigation second only to the celebrated Credit Mobilier of the States, and quite an excitement was raised in parliament by the governor-general when, in concluding his speech prorogueing that body, he announced that he had ordered a commission should be issued to inquire into certain matters connected with the Canadian Pacific railroad. Mr

M'Kenzie, leader of the opposition, moved a resolution condemning the removal of the investigation from the parliamentary to the royal committee, and proceeded to speak amid great tumult, until the usher of the Black Rod appeared and delivered his message, and the speaker, with the supporters of the government, left the chambers to hear the governor's speech, followed with the groans and hisses of the opposition. M'Kenzie rather broadly hinted that the intention was to whitewash the transaction privately, and not allow a full and impartial investigation.

——There seems no end to difficulties among the Indians. On the 24th of July an attempt was made to arrest Sancho, a notorious thief and murderer, of the Apache tribe, at Tule Rosa, New Mexico; but the tribe took up arms for his protection, and Mr. Benjamin M. Thomas, the agent, being overawed by superior numbers, reported the matter to Gen. Pope, asking that the arrest be made by force, if necessary. A force under command of Major Rice was dispatched accordingly, but at last advices had not succeeded in securing Sancho. Not content with raiding upon his natural enemy, the white man, the aborigine always has a large collection of ancient quarrels with some other tribe on hand, and never lets an opportunity slip of repaying with interest some real or fancied wrong. Early in August a party of Pawnees numbering, including squaws and papooses, about 300, engaged in their annual hunt in the Great Republican valley, were attacked unawares by a war party of Sioux numbering about 1,500. The Sioux were well mounted and armed; the Pawnees were not; and the result of the battle was a defeat of the Pawnees—the victorious Sioux managing to get between the Pawnee warriors and their squaws and papooses, all of whom they massacred. The defeated tribe lost over 100 killed, besides all their ponies—a blow from which they will not immediately recover, though they are said to be organizing a large force to carry war into the enemy's country.

The military commission convened at Fort Klamath, Oregon, has convicted and sentenced to be hanged the Modoc captives, Captain Jack, Schonchin, Black Jim, Boston Charley, Barncho, *alias* One-eyed Jim, and Sloluck, *alias* Cok, for the murder of General Canby and Commissioner Thomas, and assault with intent to kill other peace commissioners. They are found guilty of two specifications and two charges. The proceedings have been approved by the president and secretary of war, and the sentence will be carried into effect at Fort Klamath on the 3d of October, under the direction of the general commanding the department of Columbia. This is, however, balanced by the proposed release of Santanta and Big Tree, who recently passed through Houston, Texas, under guard. Their destination was Fort Sill, where a council was to be held between Secretary Delano and Governor Davis on the one side, and the Kiowas and Comanches on the other, "with a view to further peace."

——If we are to judge of southern and western society by the reports of lawlessness prevalent in those sections, we are forced to the conclusion that anarchy is uppermost. The Southwest has for the past few weeks shown a succession of quarrels, more or less trivial, engendering murderous affrays. Respect for legislative action, never very great, is rapidly waning, and is the natural result of the prostitution of legislatures to private aggrandizement, and also the prevailing habit of ascribing corrupt motives to members of those bodies upon any and every occasion they may happen to differ with the critic and vote accordingly. There is a growing distrust of officers of the law and the verdicts of juries which their conduct does not by any means justify, and which is assuming alarming proportions. There may be some excuse for popular usurpation of law where, as in California in 1849, every department of justice was banded with criminals; but no such state of affairs exists at present in the Southwest. Perhaps the most outrageous example of this "speedy justice," as it is called by its admirers, took place at Fulton, Mo , recently. A person by the name of Kessler was arrested, tried, and convicted of stealing several mules, and sentenced to the penitentiary for six years. While being transported from the court-house to the train, the carriage was surrounded by an armed mob who essayed to shoot the prisoner, but only succeeded in wounding the sheriff and several other persons instead. The carriage was then stopped, the prisoner taken out, and, after being allowed five minutes to prepare for death, was hanged. There is one hope connected with scenes like this—that is, that their enormity will arouse the country to a sense of its danger, if they are allowed to continue.

——People in all advanced manufacturing and commercial nations are growing richer The annual return from the trustee savings banks of the United Kingdom shows that at the end of their year, November 20, 1872, the amount due to depositors was £39,680,652, namely:—In England and Wales, £32,546,401; Scotland, £4,452,492; Ireland, £2,221,852; and in the Channel islands, £459,907. To this is to be added £19,318,339, due at the end of 1872 to depositors in post-office savings banks, making the total deposits in round numbers £59,000,000 sterling. Deposits increased in 1872 by upwards of £3,000,000; in post-office savings banks by more than £2,250,000; in the trustee savings banks by £860,000. The number of accounts open was nearly equal in the two classes of savings banks; in the trustee savings banks 1,425,147, and in the post-office banks 1,442,448. The number of accounts will soon reach 3,000,000.

——The Patrons of Husbandry continue to increase in numbers, not only in the Western States, where the order was first instituted, but in the Eastern. The General Deputy of the order in Pennsylvania announces that there are in the State thirteen organized granges and five awaiting organization, and the foundations of more than one hundred have been laid. In Boston a number of gentlemen, mostly grain merchants, had a meeting lately, and organized the Boston grange of the order. It is also proposed to form granges at all the principal grain ports on the Atlantic coast. This puts a new phase to the affair.

——The prosecution of the Italian padrones in New York has commenced in good earnest, and the example should be followed in every city in the land where organgrinders are found. The testimony in the New York case shows a deplorable state of affairs. The boys are kidnapped in Italy, transported to this country, and kept in a state of absolute slavery more onerous than that of the average plantation negro in days gone by. The officers who made the arrest of a padrone found about 150 small boys in one house, nearly all of whom were tied to the wall and bore marks of most inhuman usage.

——Another immigration of Mennonites, numbering about twenty-five families, is reported at New York from southern Russia. They bring about $350,000 in gold, and intend settling in Dakota and further south, on the line of the Southern Pacific railroad.

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PUBLIC EXPENDITURE, DEBT, AND TAXATION.

[No. 2.]

GROWTH AND MAGNITUDE OF PUBLIC AND CORPORATE INDEBTEDNESS.

THE present deserves to be characterized as the era of debt. It may be safely asserted that never before in the history of the world was borrowing prosecuted on so large a scale. A corporation or political community without a debt is a financial anomaly. Private, corporate, and, to some extent, public indebtedness, is interwoven, both as a cause and consequence, with commercial activity, and has kept pace with its progress. So far as debts are incurred in carrying on legitimate business operations, they play an important and useful part in the creation of wealth. Their function is to concentrate and distribute capital where industrial conditions demand it. Credit is therefore the very right arm of business enterprise, and, as an aid to production, has been almost equal to an additional force in nature. In regard to a national loan, the economy of it is not that it diminishes (except so far as loans are contracted abroad) the drain upon the aggregate national resources, but that it enables the nation to draw capital from quarters where it can be spared with the least inconvenience and interruption to industry, instead of assessing a tax which would be exacted from all classes and conditions with the stern inflexibility of law. The burden in either case would be the same, but its present pressure would be distributed very differently. There are many cases in which, if a nation were to raise by taxation a revenue sufficient to meet its expenditures, the pressure at certain points would cause, by the derangement of industry and the suspension of production, an additional loss to the community greater perhaps than the amount of the tax. Under certain conditions, therefore, especially where some sudden emergency creates a necessity for an unusually large expenditure, all nations acknowledge in practice what is rarely disputed in theory—that it is more economical to raise a portion of the revenue by borrowing. The economical principle is the same in the case of both public and private indebtedness: both arise from the effort to meet a demand for capital by drawing it from points at which it can best be spared.

The aggregate of debt and investment in all nations can be determined at best only approximately. The London Economist, one of the best of financial authorities, made an estimate in 1870, based on a work of "Fenn on the Funds," that early in the previous year the amount had reached $27,200,000,000. According to a statement published by the bureau of Statistics, from the *Moniteur des Intérêts Matériel*, the amount of the loans contracted in various countries in 1870 was $1,099,340,000, and in 1871 $3,118,000,000, making the total for the two years $4,217,340,000. Unless more than a third of this sum was a conversion of old debts into new, the net increase was sufficient to carry the total up to $30,000,000,000 in 1872. Large as this sum is, it will not appear an extravagant estimate when we come to examine the question more in detail. As the total of national indebtedness is known to be in excess of $20,000,000,000, and as the railroad debt in the United States, Great Britain, and probably some other nations, is nearly equal to the national debt, the remaining $10,000,000,000 will appear, if anything, too small an allowance for the multitudinous forms of indebtedness due from corporations and subordinate political divisions, not to mention individual debts. The debts of the world, then, make a sum equal to three-fourths of the total wealth of the United Kingdom, and greater than the wealth thus far accumulated in the United States in gold value. It would take the products of nearly five years' labor of all the people of the United States to pay them. They amount to about $22 to each of the earth's inhabitants, on an average; but as the bulk of them is borne by nations having an aggregate population of less than 400,000,000, the average to each inhabitant in these nations is upwards of $75. The interest on this sum of $30,000,000,000 at 5 per cent. would be $1,500,000,000, or a little more than one dollar to each inhabitant of the earth, and about $3.75 to each inhabitant of the indebted countries. Two-thirds of this—being $1,000,000,000, or $2.50 per capita—consists of interest on national debts, which must be met by taxation, making more than a third of the revenues of the indebted countries.

Owing to their peculiar political relations and complications, European nations owe about four-fifths of all the national debts in the world. The total indebtedness of the principal European States near 1872 was $16,522,350,000, or $49.74 per capita, against $11,128,750,000, or $36.92 per capita, near 1863; $8,312,725,000, or $30.56 per capita, near 1854; and $7,215,817,000, or $31.02 per capita, near 1826. To pay the interest on these debts an annual taxation of $750,000,000, or $2.25 per capita, is necessary, making about one-third of the aggregate national revenues of Europe. As these fall short of the expenditures to the amount of about $100,000,000 a year in time of peace, and to a much larger amount in time of war, the increase is likely to continue till standing armies are dispensed with and war is no longer a means of settling international disputes. The increase has been wholly on the continent, the debt of Great Britain having been reduced nearly $300,000,000 since 1826. At that time the British debt was greater, and in 1854 but little less, than the debts of all the other European powers combined. Now the debts of the continental States are more than three times as large as that of Great Britain. The latter, which at the close of the contest with Napoleon amounted to the alarming proportion of 40 per cent. of the estimated national wealth, is now but about 9 per cent. This absolute and relative improvement in the financial condition of Great Britain is one of the victories of peace, over which the nation may justly feel proud. Her sacrifices and triumph in keeping faith with the public creditors under a pressure so severe, should put to shame the contemptible demagogues who would teach repudiation to the American people with their lighter burdens and more bountiful resources. The results of a large debt, or rather of the destruction of so much capital in war, upon the social condition of the British people, is in part manifest in the increase of pauperism, as shown by the growth of the poor rates. This is as follows in relation to the increase of the national debt:—

Year.	*Debt.*	*Amt. expended for relief of poor in England and Wales.*	*Amount per head of population.*	
1749	£ 78,167,000	£ 689,000	2*s.*	2*d.*
1763	138,865,000	965,000	3	0
1784	249,851,000	1,912,000	4	7
1818	833,473,000	7,890,000	13	4
1871	737,400,000	7,886,724	6	14¼

From the first period named to the present time, when the sums expended for the relief of the poor are only about one-half as much per head of population as in 1818, they have increased or diminished nearly in proportion to the increase or diminution of the debt. It is evident that Great Britain has paid dear for her maritime supremacy and whatever of influence she may have gained in continental politics.

The debt of the South American States, near 1872, amounted to $641,940,000, or $24.08 per capita, against $278,802,000, or $12.70 per capita, near 1863; $241,576,000, or $14.82 per capita, near 1854; and $155,892,700, or $12.02 per capita, near 1826. The debt of India was, in 1872, $541,000,000, against $507,000,000 in 1863; $220,400,000 in 1854; and $145,000,000 in 1826. The debt of Egypt, almost entirely created in the last twenty years, is $150,000,000. The Australian colonies have a debt of $186,108,000, against $81,843,750 near 1863, the debt being then of recent date.

Now, coming home, we find, also, the debt of the North American States, near 1872, to be $2,421,742,000, or $43.21 per capita—consisting mainly of the national debt of the United States—against $262,377,306, or $5.91 per capita, near 1861; $146,349,206, or $3.90 per capita, near 1854; and $173,641,000, or $7.96 per capita, near 1826. The total debt of all the nations thus far mentioned, so far as known, foots up in round numbers $20,600,000,000, or $32.71 per capita, near 1872, against $12,270,000,000, or $22.55 per capita, near 1863; $8,921,000,000, or $19.42 per capita, near 1854; and $7,690,000,000, or $19.98 per capita, near 1826. From 1826 to 1854, the date of the breaking out of the Crimean war, being a period of comparative political tranquility, the magnitude of the national debts was but little increased. The frequent wars which since that date have disturbed the peace of the world, have brought forth their legitimate fruit in more than doubling the national debts of the nations concerned. Though the burdens thus created draw heavily upon industry, there is this compensation: that they place nations under bonds to keep the peace. Till the downfall of Napoleon in 1815, the policy of Great Britain had been for a long period steadily warlike; but the £600,000,000 added to her debt in the struggle with the French revolution and Napoleon, converted her into one of the most peaceful of European nations. It will be no small compensation for the hard terms wrung from humiliated France, if the increased burdens thus thrown upon her shall compel an abandonment of those ambitious schemes which, under the régime of Cæsarism, made her a standing menace to the peace of Europe.

In order that a nation's credit may be maintained, its revenue must bear a certain proportion to its debt. This proportion varies in different nations according to circumstances. In Europe, where credit is more extended than elsewhere, the actual ratio of revenue to debt has, since 1826, varied between 13 and 15 per cent.; standing for the present at the former figure. In other words, it would take the revenues of nearly eight years to pay the national debts of Europe. In South America the ratio of revenue to debt is 19 per cent., being the smallest since 1826. In North America it is 17 per cent., also a smaller ratio than at any time since 1826, but sufficient to pay the debts in six years. The ratio in all the countries referred to is 14 per cent., or sufficient to pay the debts in about seven years. It illustrates the economical value of political stability that the turbulent republics of South America, with revenues equal to 19 per cent. of their debts, have already overtaxed their credit, while the European States, with revenues equal to only 13 per cent. of their debts, and heavily taxed at that, are far from having exhausted their capacity to borrow.

The indebtedness of the United States, in its various forms, demands more particular attention. Aside from individual debts, it consists of sums due from the nation, from the States, from the counties, cities, and towns, and from corporations. The national debt, though large, is less in proportion to the national wealth than that of Great Britain, and is diminishing. The August statement gives the principal of our debt at $2,239,021,954. The wealth of the nation in 1870, according to the census, was $30,068,518,507 in currency, and as the increase in time of peace is usually about 6 per cent. per annum, the wealth of the country at the present time cannot be less than $35,000,000,000 in currency, or $28,000,000,000 in gold, taking the ratio of gold to currency as 125 to 100, or a little higher than the current market quotations, to allow for the artificial depreciation of gold itself, which our political economists suppose to exist in this country. The debt is therefore only about 8 per cent. of the national wealth, while in Great Britain it is as previously stated about 9 per cent. At the beginning of Jefferson's administration the principal of the debt was $83,000,000, which was 7.73 per cent. of the national wealth. In 1816, when the debt was swollen by the war of 1812 to a greater magnitude than at any time in our history prior to the rebellion, it amounted to $127,334,900, which was 7.07 per cent. of the national wealth. Though the absolute magnitude of the debt is twenty-seven times as large as at the first date named, and nearly eighteen times as large as in 1816, the proportion it bears to the wealth of the country is scarcely increased.

The debts of the several States began to assume importance between 1820 and 1830, during which time the amount of bonded debt created was about $26,000,000, wholly by the Middle, Southern, and Western States. At the former date there were no State debts of any considerable magnitude, while the Eastern States, up to 1835, had created debts to the amount of only about half a million. From 1830 to 1835 the amount of debt created in all the States was $43,512,766. From 1835 to 1840, under the impulse of the agitation for internal improvements, the increase was much more rapid, the amount created being $134,896,318.—At the close of 1840 the amount of bonded and other State debts had reached $198,367,455, or $11.65 per capita. In 1850 the total debts of the States, absolute and contingent, according to the American Almanac, amounted to $209,305,552. The annual interest on the absolute debt of $169,549,000 was $8,577,646, being at an average rate of $5\frac{1}{16}$ per cent. The interest on the whole debt, at the same rate, would have been $10,596,000. In 1860 the whole debt had risen $264,921,272, and the interest on the absolute debt of $197,923,117 was $11,385,655, or at an average rate of 5¾ per cent., at which rate the interest on the whole would have been $15,232,973. According to the census of 1870 the debts of the States were $352,906,133, or $9.26 per capita, being $2.39 less per capita than in 1840, and 76 cents more per capita than in 1860. The interest on the State debts at 6 per cent. would be $21,174,367, or 55½ cents per capita, which was a little less than one-third the State taxation. The State debts bore a proportion to the national wealth of 1.22 per cent. in 1870, against 1.65 per cent. in 1860, and 5.27 per cent. in 1840. The county, city, and town debt, respecting which we have complete statistics only in 1870, was at that time 511,878,944, or $13.32 per capita, being 1.77 per cent. of the national wealth. The interest on this sum at 6 per cent. would be $30,712,000, or $1.36 per capita, or a trifle over one-seventh of the county and town taxation. The total public debt, with which the people of the United States are burdened, foots up as follows:—

National debt in 1873	$2,239,021,954	Interest	$108,000,000
State debts in 1870	352,906,133	"	21,174,000
County, town, and city, in 1870,	511,878,944	"	30,712,000
Total	$3,103,807,031	Interest	$159,886,000

The State and local debts, though for 1870, are probably not less now; so that the above gives the minimum burden. The principal is not less than $77.59 per capita of our present population, and 11.08 per cent. of our present wealth, while the payment of the interest requires about $2.85 out of every $100 earned by the nation. The payment of interest on the various public debts adds 36.6 per cent. to our annual taxation.

Besides the debts already enumerated, there is a large amount of corporate indebtedness which deserves attention, though its total amount cannot be given with precision. Of this, the railroad debt constitutes the principal item, and, according to Poor's Manual, amounted at the close of 1872 to $1,511,378,944 on 57,323 miles of road, costing $3,159,423,000; in 1857, according to a statement accompanying the report of the secretary of the treasury, to $417,243,664 on a total cost of $908,679,325; and in 1853 to $130,000,000 on a cost of $451,644,000. The canal debt in 1872 was about $50,000,000. The liabilities of the National banks for their circulation and deposits amounted in February last to $1,003,004,782, on which, of course, no interest is payable. Their loans and discounts, which are either individual or corporate debts of a temporary character, amounted to $906,189,197. In 1860 the circulation and deposits of the banks were $460,904,606, and the loans and discounts $691,945,580. In 1850 the former were $240,953,121, and the latter $364,204,078. In 1834 the amounts were $170,506,559 and $324,119,499 respectively. The increase illustrates the rapid growth as well as the colossal dimensions of our trade. Besides the loans of the banks at the present time, as given above, there is a loan from the banks to the national government, already reckoned as a part of our national debt, to the amount of $383,450,000 in bonds to secure their circulation. Even then the total of loans and discounts will be less in relation to resources than either in 1860, 1850, or 1834. The total amount of savings bank deposits, which are in turn invested in securities of various kinds, or lent to individuals or corporations, is not accurately known; but in New England and New York, at the close of 1871, the amount was $580,249,345. These sections had at that time 57 per cent. of all the national bank capital in the United States, and as it is not unreasonable to suppose their proportion of all the savings bank deposits in the Union to be equally large, it will probably be not far from the truth to place the latter in round numbers at $1,000,000,000, which corresponds with the amount as stated in the newspapers. The public and private indebtedness thus far enumerated foots up as follows:—

Public indebtedness	$3,103,807,031
Railroad and canal debt	1,561,378,944
Bank circulation and deposits	1,003,004,782
Bank loans and discounts	906,189,197
Savings bank deposits	1,000,000,000
Total	$7,574,379,954

This, in mixed values, makes about 21 per cent. of our national wealth, and one-fourth of the debt and investment in all nations. These figures may well startle the imagination. They indicate an enormous extension of credit, resulting from a corresponding expansion of trade. They measure the magnitude of the changes that might take place in the possession of property, if we could imagine a universal liquidation. The same results, in part, would be produced by a partial liquidation. So large a volume of indebtedness, with so great a proportion consisting of bank credits which can be called for on short notice, and of an expanded and irredeemable currency which stimulates extravagance, furnishes conditions of unstable equilibrium in our money markets. Credit, though a good servant, is a bad master. It is a two-edged sword. A forced contraction of credits to a comparatively small amount—a thing liable to occur on the first note of alarm—might end in sending panic and dismay through all our commercial centres. But, even if no such calamity occurs, existing conditions afford a paradise for speculators and gambling adventurers who rob the producing classes, and inflict incalculable injury upon legitimate business. "Black Friday," and similar more recent disturbances in New York city, show what class profits by uncertainty.

The large volume of the evidences of our indebtedness held abroad introduces additional complications. This has been increasing for several years. In 1869 Commissioner Wells estimated the amount of our foreign debt at $1,465,500,000, of which $1,000,000,000 were national securities, while he placed the annual increase at $210,000,000. Later information indicates that this estimate is rather below than above the truth. The London Economist in March, 1870, published a list of the dealings in foreign stocks at the London stock exchange, in which the amount set down against the United States was upwards of $2,000,000,000; and Germany is said to have $900,000,000 to $1,000,000,000 in our securities. The present amount of these held abroad is stated by competent authorities at $2,500,000,000, on which the annual interest can scarcely be less than $150,000,000. It must not be supposed that we obtained for these securities their full face value. They were most of them sold at a heavy discount, estimated by some authorities as high as 25 per cent. on an average, which would make the annual interest on the sum actually received equal to 8 per cent. So great has been the demand for foreign capital that we have been willing to procure it at almost any sacrifice. While the policy of obtaining capital to develop our resources from countries more abundantly supplied is not to be wholly condemned, the spirit of the warning against "entangling alliances" of a political nature should caution us against involving ourselves too deeply in the financial complications of Europe.

In this connection the state of our foreign trade deserves notice. The value of our imports of foreign merchandise for consumption, in the calendar year 1872, was $638,898,180, or $15.62 per capita, against $14.06 in 1871, $11.55 in 1870, $11.37 in 1869, $9.79 in 1868, $10.58 in 1867, and $12.27 in 1866, when the large sums disbursed among the soldiers caused an exceptionally large trade. Adding to the value of the imports for consumption the interest on our foreign debt, estimated at $150,000,000, and what we have to pay for excess of freight carried in foreign bottoms, estimated by Commissioner Wells in 1869 at $24,000,000, and now probably not less than $35,000,000, and we have a total of $823,898,180 to be paid for by our domestic exports, or by sending abroad more securities. Our net domestic exports, including specie, in gold values were $530,648,473, leaving $293,249,707 to be paid for in some other way. How much should be deducted from this sum on account of mercantile profits cannot be ascertained. But, after making liberal allowance for this, the adverse balance remaining to be settled by sending abroad more stocks and bonds must amount to a sum equal to, or greater than the interest on our foreign debt. Suppose, now, that this market for our securities should be cut off, and foreigners should call for something besides promises in settlement of balances; or, still worse, that any considerable proportion of our securities should be sent home—it is evident that our position would be a critical one. The floating capital received in exchange for our obligations has been locked up in the form of fixed capital, and, though likely to prove ultimately productive, cannot be made immediately available. We cannot export our railroads and canals. The drain upon the portion of our capital available for exportation could hardly fail to cause serious derangement in our markets. Our two severest commercial crises—those of 1837 and 1857—were preceded by a state of our foreign trade similar to what we have witnessed in the last five years. Previous to the first, the value of imports consumed and in store in the United States rose from $4.31 per capita in 1830 to $6.25 in 1833, $7.09 in 1834, $8.64 in 1835, and $10.93 in 1836. Previous to the second, these values rose from $6.13 per capita in 1849 to $7.95 in 1852, $9.88 in 1853, and $10.71 in 1854; fell to $8.67 in 1855; went up again to $10.77 in 1856, and culminated at $11.81 in 1857, when the grand crash came. Overtrading in foreign goods has ever in our history proved a source of disaster: and yet we seem to be repeating our past folly in this respect, as is shown in the increase of our imports consumed and on hand from $10.50 per capita in 1859 to $15.62 per capita in 1872, or at the rate of 48.76 per cent. This increase has taken place wholly within the last five years, as has already been shown, and appears to have been fully maintained during the first ten months of the *fiscal* year 1873. The imports of foreign merchandise for consumption during that time were $524,567,698, or at the rate of $612,000,000 for the whole year. The reduction in the amount in the warehouses since June 30, 1872, is $50,000,000, which, added to the imports as estimated, gives a total consumption of foreign goods for 1873 equal to $662,000,000, or $15.72 per capita, against estimated net exports, including specie, of $554,600,000. Reckoning the interest on our foreign debt and what we pay for the excess of freight carried in foreign bottoms, the adverse balance, June 30, 1873, mounts up to nearly $300,000,000. The first four months of the *calendar* year 1873 show no falling off in the rate of importation, though the increase of exports is likely to reduce somewhat the balance against us.

The circumstances demand greater economy in the style of living, a reduction of indebtedness to the point of stability, and caution in locking up capital where it cannot be made available in an emergency. Already the symptoms of a commercial crisis are visible. The number of failures in the United States in 1872 was 4,069, with liabilities equal to $121,056,000, an amount greater than in any year since 1857, with the exception of 1861, when the number of failures was 6,993, and the liabilities $207,210,000. It behooves the community, especially the mercantile classes, to awake to the dangers which are impending. They may be warded off or hastened on, according as prudence or recklessness shall rule the hour.

SOLAR CHANGES AND WEATHER PREDICTIONS.

THE tendency, at present, amongst those who are desirous of forming a scheme of weather prediction, says Richard A. Proctor, is to seek the origin of our weather-changes in changes of the sun's condition, and by determining the laws of the solar changes to ascertain the laws which regulate changes in the weather. The simple combination of terrestrial considerations with the effects due to the sun's varying daily path having thus far failed to afford any interpretation of the varying weather from year to year, it is natural to inquire whether the variations in the sun's condition from year to year may not supply the required means of interpreting, and hence of predicting weather changes. We know that the sun's condition does vary, because we sometimes see many large spots upon his surface, whereas at others he has no spots, or few and small ones. We can scarcely doubt that these variations affect the supply of heat and light, as well as of chemical action, and possibly of other forms of force; and hence we are certainly dealing with a *vera causa*, though whether this real cause be an efficient cause of weather changes remains yet to be determined.

It may perhaps be as well to inquire, however, in the first place, whether any peculiarities of weather can be traced to another circumstance which ought to be at least as efficient, one would suppose, as any changes in the sun's action due to the spots. I refer to his varying distance from the earth. It is known doubtless to all my readers that in June and July, although these are our summer months, the sun is farther away than in December—and this not by an inconsiderable distance, but by more than three millions of miles. Accordingly, on a summer day in our hemisphere we receive much less heat than is received on a summer day in the southern hemisphere. Or, instead of comparing our summer heat with summer heat in the southern hemisphere, we may make comparison between the quantity of heat received by the whole earth on a day in June and on a day in December. Either way of viewing the matter is instructive; and I believe many of my readers will be surprised when they hear what is the actual amount of difference.

We receive in fact, on June 30th, less heat and light than dwellers at our antipodes receive on December 30th, by the amount which would be lost if an opaque disc, having a diameter equal to one-fourth of the sun's,* came upon the sun's face as seen on December 30 at our antipodes. It need hardly be said that no spots whose effects would be comparable with those produced by such a disc of blackness have ever been seen upon the face of the sun. Spots are not black or nearly black, even in their very nucleus. The largest ever seen has not had an extent approaching that of our imagined black disc, even when the whole dimensions of the spot—nucleus, umbra, and penumbra—have been taken into account. Moreover, all round a spot there is always a region of increased brightness, making up to a great degree, if not altogether, for the darkness of the spot itself. So that, unquestionably, the summer heat in the southern hemisphere exceeds the summer heat in our hemisphere to a much more marked degree than the heat given out by the sun when he is without spots exceeds the heat of a spotted sun.

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* It is easily shown that such would be the size of the imagined black disc; for the sun's distance varies from about 93,000,000 of miles to about 90,000,000, or in the proportion of 31 to 30. Hence the size of his disc varies in the proportion of 31 times 31 to 30 times 30, or as 961 to 900. The defect of the latter number 900 amounts to 61, which is about a sixteenth part of the larger number. But a black disc having a diameter equal to a quarter of the sun's would cut off precisely a sixteenth part of his light and heat, which was the fact to be proved.

It is, however, rather difficult to ascertain what effect is to be ascribed to this peculiarity. It is certain that the Australian summer differs in several important respects from the European summer; but it is not easy to say how much of the difference is due to the peculiarity we have been considering, and how much to the characteristic distinction between the northern and southern halves of the earth—the great excess of water-surface over land-surface in the southern hemisphere. It is worthy of notice, however, that even in this case, where we cannot doubt that a great difference must exist in the solar action at particular seasons, we find ourselves quite unable to recognize any peculiarities of weather as *certainly* due to this difference.

I have spoken of a second way of viewing the difference in question, by considering it as it affects the whole earth. The result is sufficiently surprising. It has been shown by the researches of Sir J. Herschel and Pouillet, that on the average our earth receives each day a supply of heat competent to heat an ocean 260 yards deep over the whole surface of the earth from the temperature of melting ice to the boiling-point. Now, on or about June 30, the supply is one-thirtieth less, while on or about December 30, the supply is one-thirtieth greater. Accordingly, on June 30, the heat received in a single day would be competent only to raise an ocean 251⅓ yards deep from the freezing to the boiling-point, whereas on December 30, the heat received from the sun would so heat an ocean 268⅔ yards deep. The mere excess of heat, therefore, on December 30, as compared with June 30, would suffice to raise an ocean more than 17 yards deep, and covering the whole earth, from the freezing-point to the temperature of boiling water! It will not be regarded as surprising if terrestrial effects of some importance should follow from so noteworthy an excess, not merely of light and heat, but of gravitating force, of magnetic influence, and of actinic or chemical action, exerted upon the earth as a whole. Accordingly, we find that there is a recognizable increase in the activity of the earth's magnetism in December and January as compared with June and July. But, assuredly, the effect produced is not of such a character as to suggest that we should find the means of predicting weather *if* it were possible for us *now* to discover any solar law of change resulting in a corresponding variation of solar action upon the earth.

This leads us to consider the first great law of solar change as distinguished from systematic variations like the sun's varying change of distance and his varying daily path on the heavens. This law is that which regulates the increase and decrease of the solar spots within a period of about eleven years. The sun's condition does not, indeed, admit of being certainly predicted by this law, since it not unfrequently happens that the sun shows few spots for several weeks together, in the very height of the time of spot-frequency; while, on the other hand, it often happens that many and large spots are seen at other times. Nevertheless, this general law holds that, on the whole, and taking one month with another, there is a variation in spot-frequency, having for its period an interval of rather more than eleven years.

Now, the difference between a year of maximum spot-frequency and one of minimum frequency is very noteworthy, notwithstanding the exceptional features just mentioned, which show themselves but for short periods. This will be manifest on the consideration of a few typical instances. Thus, in the year 1837, the sun was observed on 168 days, during which he was not once seen without spots, while no less than 333 new groups made their appearance. This was a year of maximum spot-frequency. In 1843 the sun was observed on 312 days, and on no less than 149 of these no spots could be seen, while only 34 new groups made their appearance. This was a minimum year of spot-frequency. Passing to the next maximum year, we find that in 1848 the sun was observed on 278 days, during which he was never seen without spots, while 330 new spots made their appearance. In 1855 and 1856 together, he was observed on 634 days, on 239 of which he was without spots, while only 62 new groups made their appearance. The next maximum was not so marked as usual—that is, there was not so definite a summit, if one may so speak, to the wave of increase; but the excess of spot-frequency was none the less decided. Thus, in the four years 1858, '59, '60, '61, the sun was observed on 335, 343, 333, and 322 days, *on not one of which he was spotless*, while the numbers of new groups for these four years were respectively 202, 205, 211, and 204. The minimum in 1867 was very marked, as 195 days out of 312 were without spots, and only 25 new groups appeared. The increase after 1867 was unusually rapid, since in 1869 there were no spotless days, and 224 new groups were seen, though the sun was only observed on 196 days. The number of spots in 1870 ,1871, and 1872, as well as their magnitude and duration, have been above what is usual, even at the period of maximum spot-frequency.

From all this it will be manifest that we have a well-marked peculiarity to deal with, though not one of perfect uniformity. Next to the systematic changes already considered, this alternate waxing and waning of spot-frequency might be expected to be efficient in producing recognizable weather changes. Assuredly, if this should not appear to be the case, we should have to dismiss all idea that the sun-spots are weather-rulers.

Now, from the first discovery of spots, it was recognized that they must, in all probability, affect our weather to some degree. It was noticed, indeed, that our auroras seemed to be in some way influenced by the condition of the sun's surface, since they were observed to be more numerous when there are many spots than when there are few or none. Singularly enough, the effect of the spots on temperature was not only inquired into much later (for we owe to Cassini and Mairan the observation relating to auroras), but was expected to be of an opposite character from that which is in reality produced. Sir W. Herschel formed the opinion that when there are most spots the sun gives out the most heat, notwithstanding the diminution of light where the spots are. He sought for evidence on this point in the price of corn in England, and it actually appeared, though by a mere coincidence, that corn had been cheapest in years of spot-frequency—a result regarded by Herschel as implying that the weather had been warmer on the whole in those years. It was well pointed out, however, by Arago, that "in these matters we must be careful how we generalize facts before we have a very considerable number of observations at our disposal." The peculiarities of weather in a single and not extensive country like England, are quite insufficient to supply an answer to the wide question dealt with by Herschel. The weather statistics of many countries must be considered and compared. Moreover, very long periods of time must be dealt with.*

M. Gautier, of Geneva, and later, MM. Arago and Barratt, made a series of researches into the tabulated temperature at several stations, and for many successive years. They arrived at the conclusion that, on the whole, the weather is coolest in years of spot-frequency. But recently the matter has been more closely scrutinized, and it has been found that the effects due to the great solar spot period, although recognizable, are by no means so obvious as had been anticipated. These effects may be divided into three classes—those affecting (1) temperature, (2) rainfall, and (3) terrestrial magnetism.

As respects the first, it has been discovered that when *underground* temperatures are examined, so that local and temporary causes of change are eliminated, there is a recognizable diminution of temperature in years when spots are most frequent. We owe this discovery to Prof. C. P. Smyth, astronomer royal for Scotland. The effect is very slight; indeed, barely recognizable. I have before me, as I write, Prof. Smyth's chart of the quarterly temperatures from 1837 to 1869, at depths of 3, 6, 12, and 24 French feet. Of course, the most remarkable feature, even at the depth of 24 feet, is the alternate rise and fall with the seasons. But it is seen that while the range of rise and fall remains very nearly constant, the crests and troughs of the waves lie at varying levels. After long and careful scrutiny, I find myself compelled to admit that I cannot find the slightest evidence in *this* chart of a connection between underground temperatures and the eleven-year period of sun-spots. I turn, therefore, to the chart in which the annual means are given; and noting in the means at the less depths "confusion worse confounded," (this, of course, is no fault of Prof. Smyth's, who here merely records what had actually taken place,) I take the temperatures at a depth of 24 French feet. Now, neglecting minor features, I find the waves of temperature thus arranged. They go down to a little more than 46½° of the common thermometer in 1839–40; rise to about 47¾° in 1847; sink to 47¼° in 1849; mount nearly to 47¾° again in 1852–53; are at 47° in 1856–57; are nearly at 48° in 1858–59; then they touch 47° three times (with short periods of rising between) in 1860, 1864, and 1867; and rise above 47½° in 1869. Now, if we remember that there were maxima of spots in 1837, 1848, 1859–60, and 1870, while there were minima in 1843 and 1855–56, I think it will be found to require a somewhat lively imagination to recognize a very striking association between the underground temperature and the sun's condition with respect to spots. If many spots imply diminution of heat, how does it come that the temperature rises to a maximum in 1859, and again in 1869? If the reverse, how is it that there is a minimum in 1860? I turn, lastly, to the chart in which the sun-spot waves and the temperature waves are brought into actual comparison, and I find myself utterly unable to recognize the slightest association between them. Nevertheless, I would not urge this with the desire of in any way throwing doubt upon the opinion to which Prof. Smyth has been led, knowing well that the long and careful examination he has given to this subject in all its details, may have afforded ample though not obvious evidence for the conclusions at which he has arrived. I note, also, that, as he points out, Mr. Stone, director of the Cape Town observatory, and Mr. Cleveland Abbe, director of the Cincinnati observatory, have since, "but it is believed quite independently, published similar deductions touching the earth's temperature in reference to sun-spots." All I would remark is, that the effect is very slight and very far from being obvious at a first inspection.

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* When Herschel made his researches into this subject, the law of spot-frequency had not been discovered. He would probably have found in this law, as some have since done, the explanation of the seven years of plenty and the seven years of famine typified by the fat kine and lean kine of Pharaoh's dream: for, if there was a period of eleven years in which corn and other produce of the ground waxed and waned in productiveness, it would be not at all unlikely that whenever this waxing and waning chanced to be unusually marked, there would result two series of poor and rich years apparently ranging over fourteen instead of eleven years. We have already seen that the waves of spot-waxing and spot-waning are not at all alike in shape and extent. Whenever, then, a wave more marked than usual came, we should expect to find it borrowing, so to speak, both in trough and crest, from the waves on either side. It would require but a year or so either way to make the wave range over fourteen years; and observed facts, even during the last half-century only, show this to be no unlikely event.

Next, as to rainfall and wind. Here, again, we have results which can hardly be regarded as striking, except in the forcible evidence they convey of the insignificance of the effects which are to be imputed to the great eleven-year spot period. We owe to Mr. Baxendell, of Manchester, the most complete series of investigations into this subject. He finds that at Oxford, during the years when sun-spots were most numerous, the amount of rainfall under west and south-west winds was greater than the amount under south and south-east winds; while the reverse was the case in years when spots were few and small. Applying corresponding processes to the meteorological records for St. Petersburg, he finds that a contrary state of things prevailed there. Next, we have the evidence of the Rev. R. Main, director of the Radcliffe observatory at Oxford, who finds that westerly winds are slightly more common when sun-spots are numerous than at other times. And lastly, Mr. Meldrum, of Mauritius, notes that years of spot-frequency are characterized, on the whole, by a greater number of storms and hurricanes than years when the sun shows few spots.

The association between the sun-spot period and terrestrial magnetism is of a far more marked character, though I must premise that the astronomer royal, after careful analysis of the Greenwich magnetic records, denies the existence of any such association whatever. There is, however, a balance of evidence in its favor. It seems very nearly demonstrated that the daily sway of the magnetic needle is greatest when sun-spots are numerous, that magnetic storms are somewhat more numerous at such times, and that auroras also are more commonly seen. Now, it has been almost demonstrated by M. Marié Davy, chief of the meteorological division in the Paris observatory, that the weather is affected in a general way by magnetic disturbances: so that we are confirmed in the opinion that indirectly, if not directly, the weather is affected to some slight degree by the great sun-spot period.

Still I must point out that not one of these cases of agreement has anything like the evidence in its favor which had been found for an association between the varying distance of Jupiter and the sun-spot changes. For eight consecutive maxima and minima this association has been strongly marked, and might be viewed as demonstrated—only it chances, unfortunately, that for two other cases the relation is *precisely reversed;* and in point of fact, whereas the period now assigned to the great sun-spot wave is eleven years and rather less than *one* month, Jupiter's period of revolution is eleven years and about *ten* months—a discrepancy of nine months, which would amount up to five and a half years (or modify perfect agreement into perfect disagreement) in seven or eight cycles.

But, accepting the association between weather and the sun-spot changes as demonstrated (which is granting a great deal to the believers in solar weather-prediction), have we any reason to believe that by a long-continued study of the sun the great problem of foretelling the weather can be solved? Taking the position of affairs before Schwabe began that fine series of observations which ended in the discovery of the great spot-period of eleven years, let us suppose that at that time the question had been mooted whether it might not be possible, by a careful study of the sun, to obtain some means of predicting the weather; the argument would then have run as follows: The sun is the great source of light and heat; that orb is liable to changes which must in all probability affect the supply of light and heat; those changes may be periodical, and so predictable; and as our weather must to some extent depend on the supply of light and heat, we may thus find a means of predicting weather changes. The inquiry might then have been undertaken, and undoubtedly the great spot-period would have been detected, and with this discovery would have come that partial power of predicting the sun's condition which we now possess—that is, the power of saying that in such and such a year, taken as a whole, spots will be numerous or the reverse; moreover, meteorological observations conducted simultaneously would have shown that, as the original argument supposed, the quantity of heat supplied by the sun varies to a slight degree with the varying condition of the sun; corresponding magnetic changes would be detected, and also those partial indications of a connection between phenomena of wind and rain and the sun's condition, which have already been indicated. But of the promised means of predicting the weather, the answer would be: We have found that storms in the tropics are rather more numerous in some years than others, the variations having a period of eleven years; we can assert pretty confidently that auroras follow a similar law of frequency; south-west winds blow more commonly at Oxford, but less commonly elsewhere, when the sun-spots, following the eleven-year period, are at a maximum; and more rain falls with south-westerly winds than with south-easterly winds at Oxford and elsewhere, but less at St. Petersburg and elsewhere, when sun-spots are most numerous, while the reverse holds when the spots are rare: and further, such results relate to averages only, and give no means of predicting the weather for any given day, week, or month, even as respects the unimportant points here indicated.

Astronomers *know* the great spot-period; they have even ascertained the existence of longer and shorter periods less marked in character; and they have ascertained the laws according to which other solar features besides the spots vary in their nature. It is certain that whatever remains to be discovered must be of a vastly less marked character. If, then, the discovery of the most striking law of solar change has led to no results having the slightest value in connection with the problem of weather prediction; if periodic solar changes of a less marked character have been detected which have no recognizable bearing on weather changes, what can be hoped from the recognition of solar changes still more recondite in their nature? It is incredible that the complex phenomena involved in meteorological relations, regarded as a whole—those phenomena which are but just discernibly affected by the great sun-spot period—should respond to changes altogether insignificant, even when compared with the development and decay of a single small sun-spot. It appears to me, therefore, that it is the duty of the true lover of science to indicate the futility of the promises which have been mistakenly held out.

THE USE AND ABUSE OF OILS.

THE subject which we propose briefly to discuss is of such vast importance, and so connected with mercantile affairs, illumination, railroads, machinery, and various processes of manufacture, that a volume would be required to do justice to it in each of the departments named. A comprehensive glance at the most prominent fixed oils, as lubricants chiefly, is all that can here be given, leaving the volatile oils for future consideration; and some of the habitudes of the former, and of those who deal therein, will claim our attention.

A good lubricant is one which interposes and maintains for a reasonable time a film of liquid between the shaft or spindle, and the box or step in which each respectively runs. The theory is, that the particles of liquid are spherical, and so infinitely small and infinitely hard as not to be subject to attrition. The nearest idea the mind can attain to such a supposition is of a vast collection of infinitely minute and perfectly round particles, much smaller than those of the finest graphite, moving freely as mercury, and rolling one over the other and around each other. Then imagine some bond uniting these particles, strong enough to overcome the tendency to gravitate, and allowing an attraction between them and the journal or spindle to be lubricated without detracting from their power of mutual interflowing, and we have the theoretical lubricant.

The attraction, cohesion, and adhesion are just such bonds, and because oils possess them in a higher degree than water is the reason they exceed it in lubricating qualities. Water, if it be freely and evenly applied to bearings of shafts, is probably equal to oil for lubrication; but this is seldom possible, yet in some situations it is thus used from necessity, especially for the steps of perpendicular shafts of turbine wheels. It is doubtful if anything can ever exceed pure sperm oil as the best of these important liquids; but so difficult at present is the obtaining of it in purity, and so rapidly is the sperm and whale fishery diminishing—employing now for the United States only 156 vessels—that it is not to be depended upon for a supply, even if its high cost would permit general use.*

Seal oil is largely increasing in quantity and importance. The principal fisheries are on the coasts of Labrador, Greenland, and Alaska. To give an idea of the large catches which sometimes take place, we will mention one recent account from St. Johns, N. F., the headquarters of this business. On the 5th of last March the steamer Eagle discovered a herd of more than 200,000, mostly "baby" seals, one year old, and obtained the greater part of them, besides 30,000 old ones, so that every available place in hold and on deck was crammed with blubber-pelts. The hunters slept where they could—on the piles of frozen skins, in barrels on deck, or on the floor of the forecastle, between walls of fat. The arrival of five smaller steamers is also recorded, all on the same day—total value, $397,200—besides five sailing vessels which brought 28,000 fat pelts. It is to be feared that indiscriminate slaughter will soon diminish this supply, as it has already the whales; and it is difficult to imagine what would have been the state of manufactures at present if lard oil and petroleum had not come to our aid.

The mode of obtaining oil from whale and seal blubber is by boiling, or by mechanical pressure only, in coarse bags, under hydraulic or screw-presses. For No. 1 lard oil mechanical pressure only is now used, the old processes with sulphuric acid and distillation being abandoned. No. 2 lard oil is made on a large scale at Cincinnati and Chicago, by putting the *whole* hog, except the bristles, into strong, tight cauldrons, into which super-heated steam at an immense pressure is admitted. The bones, flesh, entrails, &c., are thus dissolved into a pasty mass along with the fat, and afterwards pressed to obtain the oil. The color is light brown, body heavy, and the smell generally disagreeable. If allowed to stand in barrels or tanks, a dark, fetid deposit is made. The hogs thus used are often diseased, or inferior in some way. The oil usually sells at from 5 to 10 cents per gallon less than No. 1.

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* The principal fixed oils of commerce and manufactures are the following:—

Sperm whale, from *Physeter Macrocephalus.*
Right " " *Balæna Mysticetus,*
Elephant " " *Balænoptera Antiquorum.*
Seal, from *Phoca Vitulina.*
Walrus, from *Trichecus Rosmarus.*
Cod, " *Morrhua Americana.*
Menhaden, from genus *Alausa.*
Olive, " *Olea Europea.*
Lard, Nos. 1 and 2.
Elaine, or Red.
Tallow (Stearine, Palmatine, and Olein).
Petroleum.

Cotton-seed, from *Gossypium Barbadense.*
Linseed, " *Linum Usitatissimum.*
Palm, " *Crocus Butyracea.*
Rosin, from *Pinus Australis.*
Hemp-seed, from *Cannibis Sotiva.*
Sunflower, " *Helianthus Annus et per.*
Castor, " *Ricinis Communis.*
Rape-seed, " *Brassica Napus.*
Ground-nut, " *Arachis Hypogaea.*
Poppy-seed, " *Papaver Somniferum.*
Colza, " *Brassica Campestris.*

There are besides a large number of fixed oils less used and obtained in smaller quantities from certain nuts, (these yield about 50 per cent. of weight in oil,) kernels, seeds, roots, barks, and plants and birds, which would be tedious to name.

In obtaining olive oil, the finest quality (*Huile Vierge*) is made by pressure of the whole olive, just sufficient not to crush the seed. The oil falls into water cisterns, whence it is skimmed from the surface. A second quality (*Huile Ordinaire*) is made by harder pressure of the same pulp, mixed with hot water; and a third kind (*Huile d'Enfer*, so-called from being soaked a long time in large vats underground), by additional pressure of the same remainder, after long soaking and complete crushing of the seeds. It has the past year been proved by the success of a planter on the island of St. Simons, on the coast of the State of Georgia, that the olive can be profitably grown in the United States. From 250 trees he obtained an average of five gallons per tree.

Pure poppy oil (from *Papaver Somniferum*) is of a greenish yellow, has a pleasant, almond-like flavor, and greatly resembles olive oil, for which it is often substituted. It is also used as adulteration of the former, and—unless added in large quantities—can never be detected. As the poppy grows with but little cultivation, yielding 20 to 30 per cent. oil, which, if boiled, is almost equal to linseed, it is surprising that attempts have not been made to produce it on a large scale in the United States.

The aggregate quantity of cocoa-nut oil, rudely made in Asia and the East India islands, is very large, but little of it reaches our markets. It is mostly consumed by the natives, being burned lavishly for light in vessels partly filled with water, having the oil floating, and one or too porous sticks serving for wicks, and is also used for many other purposes. Like Olive oil in Syria, it is butter, lard, or oil, according to circumstances in cooking. It forms the basis of soaps, is used for dressing leather, and for making perfumes and cosmetics.

Cod-liver oil, (from *Morrhua Americana*), which, for curative purposes, attracted so much attention some years ago, is still largely used for medical and fine manufacturing processes, and probably owes its excellent qualities to the bromine and iodide of copper it contains.

Castor-oil, although of modern introduction, was well known to the Egyptians and Greeks—the latter calling it croton—a name now bestowed on another genus of euphorbiacoeus plants, one of which yields the *oleum tiglii*, a strongly purgative oil. Castor-oil is largely used for burning purposes in the East, Italy, and France, and in the latter country and the United States in pharmacy, manufacture of perfumery, and for lubrication. Considerable quantities of the bean are produced in the Western States—all for home consumption—averaging about 275,000 gallons per annum. The leaves of the Palma Christi (*Ricinus Communis*), from the seeds of which castor-oil is obtained, are now extensively used in Algeria as food for silk-worms, and which so fed are said to produce a superior quality and larger yield of silk.

The general public is not aware of the great quantity of oil obtained from birds. The fulmar (*Fulmarus Glacialis*), which breeds in immense numbers in the Hebrides islands, and various other parts of the northern latitudes, furnishes a large proportion of the supply. The oil has a specific gravity of .992, is of a bright red color, penetrating odor, and in pathological qualities much resembles cod-liver oil. The penguin (*g. Aptenodytes*) of the Falkland islands yields the largest amount. One schooner has been known to obtain 25,000 to 30,000 gallons in five weeks. As it requires 11 birds to furnish 1 gallon of oil, that quantity demanded the destruction of about 275,000. This oil is mostly sent to London, and is used for little else than dressing leather. The dusky petrel (*Puffinue Osbscurus*) of New Zealand is so rich in oil that on squeezing the young birds it will run pure from their mouths. The frigate-pelican (*Cachypetes Aquilus*), the ostrich, (*Strutho Ocamelus*) the cassowary (*CasuariusEmu*), the goat-sucker of Trinidad (*g. Caprimulgus*), and the *Stratorinus-Caripensis* of Venezuela, all yield in the aggregate a large quantity of oil, much of which does not enter into commerce, but is consumed by the natives, who extract it by rude and wasteful processes.

Although not quite germain to this subject, we will mention as an item of interest two modes of making artificial butter, invented by M. Casthelar, which imitation was largely substituted in Paris during the late siege, and is still used there in some restaurants. Ox tallow is gently heated along with water, potash, and macerated tripe. The product, after being salted and cooled, is pressed to remove the stearine. From the residüe, worked with equal parts of water and milk, and a coloring mixture of anatto, a very fair article of butter can be obtained. Another method is to treat tallow with a hot solution of carbonate of soda—1 part to 30 parts water. The product is washed, first in water containing 1 per cent. of muriatic acid, and afterwards in pure water.

All the seed-oils are made from seed first crushed between two heavy rollers, called a "Dutch mill," and then ground under two pairs of granite stones, five to seven feet diameter, revolving in a circle, as well as on their axes. The pasty pulp thus formed is inclosed in an inner woolen and an outer horse-hair sack, and the oil usually extracted in a "Dutch stamping press," which is formed by a number of heavy wedges, each of about 600 pounds weight, placed side by side in cases just fitting the sacks, and actuated by cams on a horizontal shaft, giving a lift and fall of 16 to 21 inches. The dry oil-cake is an excellent food for cattle, and forms an important article of export.

The bleaching of oils is most cheaply and best effected by exposure to the sunlight in shallow pans—the use of alum, bichromate of potash, or other drugs for this purpose being injurious.

To make the subject more intelligible we give here some details of the formation of this class of liquids. Oils are composed of 75 to 80 per cent. of carbon, 10 to 13 per cent. hydrogen, and 9 to 12 per cent. oxygen, as chemical constituents; and these involve the mechanical compound of stearine, margarine, and olein. The specific gravity is .913 to .970, and the boiling point 500° F. Stearine and margarine, which form the solid portions of oils, and, when separated, form the material for candles, are composed of stearic and margaric acids, respectively combined with glycerine (*Glukeros*). This can be best obtained pure by boiling olive oil with litharge and water until the acids of the oil are converted into lead salts, which are insoluble, while the glycerine remains in solution. It contains some oxide of lead, is sweet, viscid, and colorless; soluble in water and alcohol, and by action of nitric acid is converted into oxalic acid.*

It will thus be observed that the unctuous, thick, tenacious glycerine, resembling clear gum-arabic paste, has much to do with the lubricating quality, and anything disturbing its proper relation must injure the oil in that particular respect. In proof of this we have the fact that in the treatment of lard oil with sulphuric acid and distillation, to obtain the stearine and margarine for candles, a large quantity of elaine, or "red oil," is produced. The color is caused by a portion of the acid remaining after distillation, and this, together with the absence of glycerine, stearine, and margerine, makes the oleic portion alone unfit for lubrication. Many manufacturers, however, have used the elaine for oiling wool, but it is difficult to perceive how the lower price can compensate for the loss of the glycerine, &c., and the presence of the acid, which latter, though in small quantity, is certainly undesirable. The scaly, hooked surface of the wool hairs, when in contact with the carding wire, requires lubrication as much in proportion as machinery; and if these delicate hooks and scales be injured by acid, or too much friction, the fulling property of the wool will be deficient, for it depends on the interlacing of these hooks and scales contracting the length of the hair whilst gently heated by the friction of heavy rollers or hammers, and lubricated by a soap mixture, which is always used in the process, besides the oil necessary for the carding.

The immense consumption of oils, together with a deficient supply of sperm, whale, olive, and some other kinds, has caused extensive adulteration, and some singular compounds. In certain cases the combinations are of no disadvantage, and are known to the buyer or consumer; but as regards sperm and olive oils particularly, any mixture is disadvantageous, and would never be desired by the user. The same, though with less force, may be said of lard oil, where common whale or cotton-seed oils are added to cheapen the article, but this greatly increases the danger of spontaneous combustion in manufacture, respecting which we shall hereinafter have a few remarks to make.

The adulterations already alluded to afford so many facilities difficult of discovery, that they are practiced to such an extent in this country and Europe as often to deceive the most experienced dealers; and it is almost as impossible to obtain strictly pure sperm and olive oil as veritable port-wine. Large quantities of No. 1 lard oil were formerly exported to England and France, with the special object of being mixed scientifically with a moderate proportion of olive oil, and certain compounds to give the peculiar taste and greenish hue, and were returned in bottles as the best salad oil (*Huile Vierge*).

Now, however, since the recent improvement and development of cotton-seed oil it is not necessary to export, since, the latter mixed with lard oil, and the color and taste of the olive being imitated, is quite equal to the European adulteration, especially with the foreign label. Recently it has become quite common to bottle pure refined cotton-seed oil for salad use, and it is probable that by far the largest quantity of *Huile Vierge* that lubricates epicurean palates has the merit of home production to recommend it, if no other advantage. Some who claim to be judges profess to consider cotton-seed oil as equal to olive for this purpose; but as tastes vary so much, and are so easily acquired, the assertion cannot be considered authoritative. It would scarcely be expected, and yet it is true, that even cotton-seed oil is adulterated with rosin oil, which is yet cheaper, but the mixture can be detected by the alteration of odor. The growth of the manufacture and trade in this oil is extraordinary, for only a few years ago the seed was piled in heaps as useless, or spread as manure. An American merchant sent a sample of the crude oil to England, inquiring if it was possible to refine it to advantage, and at the same time expressing to his correspondent a faint hope that in the future something advantageous might be developed.

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* That most useful but dangerous liquid, nitro-glycerine, is easily obtained by mixing equal parts of nitric and sulphuric acids, cooling, and adding glycerine in very small quantities; then pouring the mixture in a very thin stream into a large quantity of water, when the nitro-glycerine is separated as a colorless, heavy oil; specific gravity 1.6. It is more powerful and dangerous than gun-cotton (*Pyroxyline*), which is a combination of ether with the product of nitric and sulphuric acids on cotton.

The vast production of petroleum oils during the past ten years has caused the making of many kinds of engine, machinery, and wool oils—the best of which, and some of them are really excellent lubricants, (quite equal to sperm oil for certain work)—are composed of 25 to 30 per cent. of refined petroleum, and 70 to 75 per cent. No. 1 lard oil. The best of the latter is so gummy in nature that an addition of six gallons refined petroleum to the barrel is a real advantage for any use, as it neutralizes the tendency to "gum" on the machines, which is sometimes exceedingly troublesome. This has become a subject of much importance, as from various causes lard oil—or mixtures with it as a base—are now more used in mills and machine-shops, and on railroads than any other oils. So serious at times is the evil, that we have known factories which had received an inferior article of this oil, and were forced to stop and have a general cleaning throughout before work could be resumed to advantage. The effect of the quality of the oil used for lubricating shafting and machinery is a matter of importance to all, especially large establishments, where the friction being increased by any gummy substance in the oil, or by the coldness of the weather coagulating the oleic portion of the lubricator, a very appreciable increase of power to drive the works is necessary. This can be noticed in any large cotton or woolen mill where the rooms are not kept fully heated during the night, as an hour or two are required after starting in the morning before the machinery can be got into proper working order. This is particularly the case in woolen mills, where the wool having been oiled—as is always necessary—the want of fluidity in the oil when cold causes the fibres of wool to adhere together, requiring much more power to card them, and producing an inferior yarn. This apparently slight cause is sometimes so troublesome in winter that frequently on the first half day of the working week there is much less than a proper average of production, and the quality considerably deteriorated. The difficulty is now in a good measure overcome by a simple oiling machine placed in front of the feed-rollers of the first-breaker card, and which sprinkles the requisite quantity of oil on the wool as it enters the machine, instead of its being placed on the layers of material when going through the opening and mixing pickers. Many manufacturers, however, still adhere to the old plan. Olive oil is the only proper oil for use in the worsted manufacture.

In a cotton mill of many spindles, on a cold winter day, quite a diminution in the power needed will be indicated by the dynanometer as soon as the numerous gas jets are lighted. It therefore becomes evident that coal burned during the winter nights to keep rooms properly heated by steam-pipes is a judicious expenditure, which is becoming more appreciated than formerly by careful manufacturers.

The remarks already made on that subject will indicate the fact—unfortunately but too easy of proof—that there can scarcely be a line of trade mentioned in which there is more adulteration than in oil. Various means have been devised to discover the purity or impurity of oils, and also to measure their fluidity and lubricating power, but though they can be compared, it is almost impossible to discover the exact sophistication. We shall mention one only of each kind.

For testing the fluidity a very simple plan was devised by Nasmyth. A plate of iron, six feet in length, having a number of longitudinal grooves of equal size, is, when placed for use, raised one inch at one end. An equal sample of each oil to be compared is then poured at the same time into the top of the grooves and allowed to flow. Some oils which the first few days of the trial appear most fluid and progress the fastest begin then to coagulate, and are passed by the better oils, some of which continue the race for eight or ten days. In one trial which was made, linseed oil flowed freely during the first day, but stopped in the space of 18 inches. The best sperm flowed most freely for two days, but on the third day was passed by common sperm, which on the ninth day reached within 2 inches of the foot of the inclined plane—the other oil having stopped on the seventh day at 54⅛ inches.

Professor R. H. Thurston, of the Stevens Institute of Technology, Hoboken, New Jersey, has recently invented a machine which seems to overcome the objections heretofore raised to the oil tests in use. A cast-iron standard, with two branches at the top, is bolted firmly to a square base. On the top of each branch is a stationary journal-box, in which runs a short iron shaft, moved by a pulley placed on it between the two boxes. At the outer end of the shaft there is a short projecting journal of steel or selected iron; suspended from this journal, and clamping it by means of adjustable boxes, is a hollow, round arm, hanging perpendicularly and loosely, which also has upon it a sliding weight fastened by a set-screw—the whole resembling a metronome reversed.

The pressure under which the oil is to be tested is obtained by turning a screw which is placed half way down the arm, and acts upon the lower part of a spiral spring contained inside the upper part of said arm, and bearing against the lower one of the loose boxes which clasp the trial journal. The pressure per square inch appears on a graduated scale outside the spring, and which is traversed by a finger. The machine being put in motion by a belt on the pulley, the friction at the last part of the proof causes the perpendicular arm to swing away from the vertical position. The "moment of friction" is indicated by a quadrant scale at the back of the swinging arm, and in which a pointer fastened on the latter moves. The "coefficient of friction" is obtained by dividing the reading on the quadrant scale by a second set of empirical divisors laid off on the upright scale of the spring. The temperature at the test is marked by a thermometer set in brass on top of the boxes around the friction journal. In using the machine a small and determinate quantity of the oil to be tested is placed on the trial journal, and the pressure on the latter being adjusted by turning the screw below the spiral spring, the machine is started at a speed that will give the desired relative velocity of rubbing surfaces. Observations are made at short intervals and recorded, until the test is closed by rapid heating, as shown by the thermometer, and excessive increase of friction, as indicated by the movable arm swinging against the stays. Competing oils are similarly tried, and the records form a perfect means of comparison.

The relative power of resisting high temperature without decomposition is another important point which can be tested by this machine. Any lubricant can be proved, whether vegetable, animal, or mineral, tallow, or mixture like axle-grease. The essential feature is the combination in one machine of apparatus for making simultaneous dynanometrical and thermometrical tests of the lubricant. There is great room for the exercise of judgment by the mechanic, manufacturer, and railroad agent, in the choice of lubricators for their special purposes, and the price of the article cannot be taken as a proof of its merit for specific uses, since the best sperm oil will, in some situations, not last as long, nor perform the work as well as an oil costing only half as much, but better suited to the purpose.

The difficulty as regards machines for testing lubricants has been the impossibility of adapting them to the investigation of any oils, and not merely for comparison of a certain class, just as the various oils used for sewing machines can easily be compared by several modes which would not be suitable tests for those adapted to the rolling stock of railroads. A very simple chemical test for factory use is to agitate two parts of the oil with one part of nitrate of mercury in a glass tube, afterwards adding a few drops of sulphuric acid and noting the changes.

A few years ago, M. Rousseau, of France, discovered that olive oil, which is one of the feeblest conductors of electricity, will, when adulterated with only one hundredth part of oil of poppies, increase the number of vibrations of a magnetic needle in a given time. Warner, an English expert, has extended this field of research, and furnished a table of resistance of fixed and volatile oils which has a special value to those interested in the purity of oils.

The composition of fine oils required for watches and sewing machines is often kept carefully secret, the recipes being considered profitable and valuable. The researches of M. W. Artus have produced a very superior oil of this kind. Take refined paraffine oil and agitate with a solution of hypochlorite of soda, and leave for awhile in repose. The oil that swims on the surface being removed is to be agitated anew with lime-water. When settled, decant and mix with a concentrated solution of sal-soda in proportion of one-fifth. It should then be rectified.

The oils suitable for machine shops and general cotton and woolen machinery are mostly alike, and require a good body, rather viscid. For woolen spindles a lighter oil; and for cotton spindles, which have a speed of 4,000 revolutions per minute, an oil of still lighter body, resembling that for sewing machines, has been found best and most economical.

Some railroads now use No. 1 lard oil for engines, and a mixture of No. 1 and No. 2 lard oil for axles, in peculiar boxes placed on the caps of the journal boxes, and filled with cotton waste or wick, to distribute the oil evenly; or, instead of this, there is used a glass globe about 3 inches diameter, which, after being filled, is closed by screwing in a nozzle about 3 inches long, which then is inverted and screwed firmly into the top of the cap of the box to be lubricated. The nozzle has a slotted wire working on a screw in the upper part, by the turning of which the oil is allowed to enter the discharge hole inside faster or slower, as may suit the occasion or the body of the oil. These tight globular oilers have saved an immense amount of oil to railroads, machine shops, and factories. If properly arranged on the shafting of a mill, one of them, holding about a gill of oil, will last without any attention for three months, and, if the speed be slow, a still longer time.

An extraordinary report comes from Troy, New York, of the invention of a new oil-box for railway axles, now being tried on a palace car between New York and Poughkeepsie. "The plan has been in use on the Lehigh Valley railroad for eight months, and when the oil-box was opened it was found to be nearly full." No cotton waste is required; the boxes are sealed, and the oil is evenly distributed over the journal. This distribution is so uniform and precise that "in summer water can be used in place of oil." If oil is used, 80 per cent. saving is claimed. Much as we hope this may prove true, it must—especially the latter part—be received *cum grano salis.*

Some idea of the great waste in oil and cotton-yarn on railroads by the old plan (still largely used, however,) can be formed, if we notice numerous establishments that now make a business of buying this oily waste at a fair price—it was almost given away a few years ago to get rid of it—cleansing and reselling the cotton waste made perfectly pure and white, and saving a large part of the oil. There are several small concerns of this kind in Philadelphia, and one large establishment, employing much capital, at Manchester, N. H. This is another evidence of the utilization of waste substances towards which attention is now constantly directed.

A new and practical method of regenerating impure and used oils has recently been invented in Austria. A wooden tub or vat, holding 64 quarts, has a spigot placed at the bottom; also a second one, a few inches higher. In 7 quarts of water at boiling point are dissolved 4½ ounces chromate of potash, 3½ ounces chloride of calcium, 3½ ounces carbonate of soda, and 9 ounces common salt. To this mixture are added 45 quarts of impure oil, and the whole, after being agitated for 15 minutes, is allowed to rest a week in a warm place, when the clear, pure oil can be drawn from the upper faucet, leaving all the impurities below. Great saving can be effected by renovating thus the drippings from the hangers of shafting in workshops and factories.

One of the greatest annoyances to the careful superintendent of a factory or machine works, and a source of loss to the owners, is the unnecessary quantity ot oil used by employés on machines, looms, and lathes, which require oiling by hand. It seems impossible to persuade operatives to use judgment, and—when provided with costly patent oil cans introduced to save waste—they will contrive some mode to render them inoperative, or little better than the oldest kind. If restricted in the quantity given out there is danger that they will allow the journals to become dry, and to cut or wear down. The only remedy—and that is but partial—is strict surveillance to see that oil is not dropped between spindles and journals, and to insist that the orifices of the small oil-cans shall remain intact.

The proper lubrication of the cylinders of steam-engines is a very important subject, not only as regards the even wearing of the cylinder and piston, but the diminution of friction—a subject which has not received from manufacturers the attention it deserves. Several forms of oil, tallow, and suet-cups have been invented—some automatic, and some requiring the use of a pump. A recently improved suet lubricator has the advantage of economy, and giving a lubricant absolutely pure, which cannot be said of the best tallow or of lard oil; but some engineers still prefer No. 1 lard oil for this purpose, believing it can be more evenly diffused over the surfaces.

The presence of acids in the lubricant of a cylinder is of great disadvantage to springs and rings of the piston, or metallic packing used instead of springs. There are engineers who insist that no lubricant, except steam itself, is needed for engine cylinders, but experience has proved this to be an error. Steam is a different thing from water, and even hot water quite different in effect from that which is cold. There is one point on which even good engineers will err. In their desire to lubricate the cylinder properly they introduce too much grease, which, passing with the condensed steam-water, which is generally pumped back, causes a tendency to foam in the boilers; and in cotton and woolen factories, where dyeing is performed and vats heated by steam, it proves injurious to certain delicate colors, if the exhaust steam be used in heating.

Within fifteen years past great economy has been obtained in woolen manufacturing by the mixture of water with oils for lubricating wool. No. 1 lard oil is generally used, though olive oil is much better, and if properly mixed with 50 per cent. water, and $\frac{1}{60}$ weight of borax or sal soda—the former being best, but the latter cheapest—there appears to be no disadvantage in the mixture; but, on the other hand, twice as much in quantity being used, it is better diffused through the wool.

Twenty-five years ago a strong effort was made by the inventor to introduce the use of steam in carding and spinning wool by the use of finely perforated pipes placed in front of the carding and spinning machines and connected with the boiler, but this plan has been abandoned, for it is found to largely diminish the production, showing that lubrication by grease is a necessity in woolen manufacturing.

There are advantage and economy in the use of the horizontal self-oiling boxes for shafts, which have been employed the past twenty years. These boxes contain woven wicks, which, by capillary attraction, yield only the amount of oil necessary for lubrication, except in case of heating, when more is delivered. These, although still largely made, are yielding to the inverted spherical oilers already mentioned. In the case of large shafts, moving at a rather high rate of speed, the safest plan is a combination of these two inventions.

Spontaneous combustion, arising from the rapid absorption of oxygen by the fixed oils, except petroleum, is now attracting much attention, and cannot be too much impressed on the public mind. The recent fire at Portland, Maine, is declared to have arisen from the leakage of linseed oil stored alongside of rags. In May last two fires, discovered first in the stable, and afterwards in the dwelling of a gentleman at Bedford, Pa., were traced directly to rags saturated with linseed oil, which painters who had been graining shutters had thrown into corners. At Jamestown, New York, a workman, who had been cleaning furniture with linseed oil, threw aside his oily apron crumpled together, and in a short time it was found in a state of ignition.

Major Majendie has recently communicated to the Royal Artillery Institute of England some interesting experiments made by Mr. Galletly on this subject. It was found that cotton-waste, soaked in boiled linseed oil and wrung out, if exposed to a temperature of 170° F., oxidized in 105 minutes. Raw linseed oil required from 4 to 5 hours before igniting; rape and olive oils 5 to 6 hours; lard oil 4 hours; castor oil 1 day; and—in one trial—olive oil ignited in 100 minutes. Sperm oil did not char the waste. His theory is, that the oil by being spread and finely divided among the fibres of the waste, has its absorbent power towards oxygen greatly increased, much as a bloom of iron will oxidize rapidly in process of manufacture if exposed to the air. It was also found that ignition took place more quickly with silk waste than with cotton. A scientific journal, commenting on this report, declares that the sperm oil of the experiment must have been adulterated with petroleum, which has a tendency to repress such oxidation, as it has been proved by other trials that sperm oil will rapidly absorb oxygen as certainly as other oils; but no case of spontaneous combustion has yet been reported from coal oils.

Many fires have occurred in woolen and cotton mills from the careless leaving of oily waste in warm places, especially during the summer months, and for safety it is necessary that such waste be removed daily. Shoddy mills, where the rags after being oiled are torn into fibre, are especially dangerous, as either from inferior oil used, or the adulteration of No. 1 lard oil with the dangerous cotton-seed oil, the shoddy often takes fire in the bags before leaving the works, or soon after reaching the mill where it is to be manufactured. Two other causes may aid in causing such fires—packing the material too soon and too tight, and putting on too much oil. The latter is a profitable arrangement, and too much practiced. The only safety for those buying is to examine the heat of each lot as received, and, if possible, open out into a pile; or, if not, let each bag be slit open and exposed to the air.

This article would be deficient without a reference to the petroleum and coal oils, which, though of recent development in large quantities, have already assumed gigantic proportions in commerce and manufacturing, and their future can hardly be imagined. The average *daily* production is now about 23,000 barrels—nearly a million gallons each 24 hours—and the quantity seems increasing and inexhaustible. The total production in the United States and Canada in 1872 was as follows: Pennsylvania, 9,539,000 barrels; West Virginia, Ohio, and Kentucky, 325,000 barrels; Canada, 530,000 barrels; total, 10,494,000 barrels, or about 420,000,000 gallons. Of course there is no allowance here for the great waste at the wells, and frequent losses by bursting of tanks and by fire. The amount stored in tanks at the wells is about 1,000,000,000 barrels, and the daily consumption of the crude oil throughout the world in 1872 was 18,500 barrels *per day.**

To give some idea of the magnitude of this new branch of trade we will state that its value—at prices of last spring, for at present there is a heavy reduction in price—is six times greater than the iron of Pennsylvania; two million dollars greater than the iron and bituminous coal of Pennsylvania, and three-fourths the value of *all* the mineral productions of California, Nevada, Montana, Idaho, and Colorado. So vast is the production that the rolling stock of the Pennsylvania Central railroad and others is taxed to the utmost to bring the oil to the ports of shipment, and new plans are being devised to facilitate the transport. Among these are tight tank cars to bring the oil in bulk, but there is more danger of the evolution of explosive gas in them, and consequent danger to trains.

Several large iron steamers, for carrying petroleum in bulk in iron tanks, have recently been built in England, to form a line from Philadelphia to Liverpool, under the control of an enterprising firm of Philadelphia (Messrs. Warden, Frew & Co.). Every precaution has been taken for safety in transit, and these are said to be the most carefully constructed steamers ever built in Great Britain. Much unwillingness has been shown to transport petroleum on the railroads of England, and the Great Eastern railroad has positively refused it until very lately, and now hampers the shipment with very difficult conditions. The same hesitation exists on some of the railroads of the United States. No railway leading west from Pittsburgh will receive benzine or naphtha in any form, yet the same roads or their connections receive them at other points, and "burning fluids" containing the same elements are freely received at Pittsburgh. The Pennsylvania Central railroad carries this class of liquids without severe restriction.

It is said that a company is being now organized in New York, with large capital, to lay piping from the oil regions to the Atlantic cities. Should gravity alone be used some difficulties present themselves, which, if they have been foreseen, have not, we believe, been mentioned. As the pipes must cross valleys by inverted syphons—which latter remain always full—should one pipe only be used, it will be impossible to prevent the mixture of different kinds of oil, leading to interminable disputes. If a number of pipes were used to New York, Philadelphia, and Baltimore, the expense would be greatly increased, and either tunnels must be bored, or some means yet unknown devised to keep the syphons filled, which shall surmount eminences of moderate height. If one kind of oil were confined to a pipe, it could be done by telegraphing from the tanks to stop the flow at the front before the oil was exhausted at the rear. In case of forcing the oil by steam power through the pipe or pipes, the same objection of a remnant of oil in syphons after pumping would still exist.*

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* There were shipped from Philadelphia alone in 338 vessels, during 1872, 1,317,833 barrels (53,000,000 gallons), value $14,000,000, to almost every port of Europe and South America, but principally to Germany.

So much loss has occurred from evaporation and leakage in the transportation and storage of petroleum, and its products—benzine and gasoline—that it is proposed to make barrels of glass, sufficiently heavy to stand the pressure and usage. These, although much more costly at first, would never wear out, and could be cleaned and used for any other fluids indefinitely. An inventor has already obtained a patent for a thick piece of glass inserted into one head of a barrel, on the part next the bung-hole, to allow the quantity within to be viewed by the buyer.

Petroleum, though not valuable as a lubricant, except in combination with other oils, or after chemical manipulation, is the principal dependence for illumination in villages and agricultural districts of this country and Europe. Recent trials prove that it can be advantageously used in furnaces under boilers for stationary, marine, and locomotive engines, as well as in the reduction of iron ore, and for stoves in family use. It has been known for several years that a jet of steam, impinging against a small stream of petroleum in a furnace, would become decomposed, and give out theoretically as much heat as that required to decompose it, since by this principle all the smoke is consumed. Efforts have been unceasingly made to perfect the arrangement for burning and for the safety of the fuel-oil, and one improved plan is suggested which may lead to important results. If a jet of steam be allowed to enter a tube, the other end being open to the atmosphere, a current of air will be drawn through and projected with the steam on the oil at a pressure corresponding to that of the former, making a powerful air as well as steam blast, and the furnace would act on the same principle as a cupola-furnace for melting iron. This would appear to be much more economical than the simple steam-jet for burning petroleum, as the oxygen of the air forced in with the steam would insure rapid and perfect combustion.

To forge iron, smelt ores, and melt glass, all that is necessary is to superheat the steam; but, for ordinary furnaces, the latter is not necessary. Although

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* The piping for crude oil already in operation in the oil districts of Pennsylvania has a total length of 675 miles, inside bore 2 inches, and gathers the oil from the following points to various places of shipment on the Alleghaney Valley railroad:—

Emlenton Pipe company, from St. Petersburg to Emlenton—capacity		1,000	bbls.	per day.
Antwerp " " " " Fullerton—	"	2,500	"	"
Mutual " " " dist. to Milford, Foxborough, and Clarion,	"	10,000	"	"
Union " " Parker's dist., etc., to Parker's landing...........	"	6,000	"	"
Fairview Pipe company, from Argyle, Petrolia, etc., to Brady's Bend..	"	5,000	bbls.	per day.
Butler Pipe company, from Grease City to Butler............	"	1,200	"	"
Total...		25,700	"	"

petroleum burned without steam blast has not yet been sufficiently economical, experiments now being made by Wiesnegg and Deville, of Paris, for furnaces of stationary and locomotive boilers, seem to point to an early solution of this difficulty.*

By various experiments it has been found that the maximum power of coal is the evaporation of eleven times its weight of water, while one pound of crude petroleum at 46 degrees Baume will convert about 24 pounds of water into steam, being about 2$\frac{85}{100}$ in proportion to coal. The average of the heat-producing power of petroleum does not fall far below this average, but that of coal is often only five to six times its weight of water. In relation to petroleum in ordinary furnaces and stoves, the Oil Trade Review, of London, commenting on the scarcity of coal in Great Britain, and the unhealthy fumes from gas-stoves, of which latter many are now used in London, advocates petroleum oil-stoves as much more economical, and expects soon to see them made so as to be portable to any part of a house like a lantern. Such stoves are being constantly improved, and are gradually coming into use, and would doubtless be largely introduced if in the future a serious scarcity of the ordinary fuels should occur.

One of the newly-discovered uses for petroleum is the prevention of scale in boilers. The usual mode of applying it to a 50 horse-power boiler is ½ gallon of petroleum with 6 to 10 lbs. of sal-soda. The boiler is to be cleaned before the first application, and the dose should be continued every two weeks. An eminent scientist states that a scale of $\frac{1}{16}$ inch in thickness on a boiler will require 15 per cent. more fuel; ¼ inch requires 60 per cent. additional, and ½ inch 150 per cent. more than if the boiler were clean.

It is believed that in a short time means will be perfected for the entire preservation of railroad ties from decay by the use of paraffine. Herr Hock, of Mariabrunn, Germany, maintains that boiling wood in it or coating with it is not fully protective. He suggests that it would be effective to impregnate the wood—first thoroughly dried—with paraffine in solution, and then, by reheating, distil over the last portions of the solvent, leaving the former in a finely divided condition in the pores of the wood. Ties thus treated would probably be perfectly protected from moisture and decay; iron spikes would not become loose; the elasticity of the wood not impaired; and any refuse from the ties would be more

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* The following experiments made the past spring in St. Louis to test the relative value of coal and petroleum in the manufacture of iron are important. In the use of petroleum it was first converted into gas:—

	Pounds.
Total amount of iron placed in furnace	26,378
Amount taken out after being rolled	24,524
Loss	1,854
Loss on the same amount of iron in coal furnace	2,901
Thus saving in iron alone by the use of gas	1,047
Which, at 3½c. ℔ lb., would amount to	$36 64
Cost of fuel (gas)	42 50
Deducting saving in iron	36 64
Cost remaining	$ 5 86
Cost of coal to make the same amount of iron	24 52

valuable as fuel. The great difficulty lies in the thorough drying of the ties; but experiments are now being made in Germany, using high pressure steam during the process, which, it is believed, will result in overcoming this obstacle.

Great efforts have of late years been made in England to produce a cheaper illuminating gas from petroleum. Should this succeed, and also the experiments on furnaces and stoves, the idea which has been advanced of heating, lighting, and furnishing power to cities by squares from various stations, may yet be accomplished in the future. We cannot here enlarge on this important subject; but, as it is probably the best of such attempts lately made, will, only in passing, refer to the petroleum gas apparatus erected by J. F. G. Kromschroeder, at Great Marlow, in Buckinghamshire, England, the working of which has elicited applause from some of the most scientific men of that country. This inventor is probably the first who has lighted a town without the use of any coal—a very important object in England at present, and indeed anywhere. He has already made the gas at cost much less than the London public works, and expects to still reduce considerably the present price. He does not claim that this will supersede large coal gas-works for great cities, but that it can be usefully and very cheaply adapted to small towns using about a million cubic feet per annum.

Although petroleum oils and their products rather repress than produce spontaneous combustion, it is not to be denied that they have caused numerous fires, some very disastrous, but generally arising from the carelessness or ignorance of those using the oils, and at times by the evolution of inflammatory gas, which became ignited through accident. Severe laws and penalties have been enacted to regulate the manufacture and sale of burning fluids from petroleum and alcohol, and the Pennsylvania law, which went in force May 1, 1873, is regarded as stringent. It is, however, surpassed by the petroleum act of England; and a person was arrested a few months since in London charged with keeping more than half a gallon of petroleum oil in the yard at the rear of his dwelling, and only escaped punishment by proving that the quantity was a little less than half a gallon.*

	Pounds.
Iron placed in scrap furnace	7,950
Taken out	7,751
Loss	199
Loss with coal 15 per cent., or	1,192
Deduct loss with gas	199
Which, at 2½c. ℘ lb., would amount to	$24 82
Cost of fuel (gas)	21 88
Saving above cost of fuel	$ 3 57

Showing the extraordinary net saving of $18.76, or 75 per cent.

It is claimed that in a specially prepared furnace the results would have increased to a very great extent the per cent. of saving. In the ordinary preparation of a blast, the time required by coal is from an hour to an hour and a half, while by gas 30 or 40 minutes are sufficient. And besides the demonstrated economy of the gas, its cleanliness was a scarcely less important feature, as evidenced in the total freedom of the smoke stacks from smoke and cinders.

* At a meeting of petroleum dealers, held in New York a few weeks ago, the following rules, among others, to govern the trade, were adopted: "Crude petroleum shall be pure, natural oil, neither steamed nor treated, and of the specific gravity of 40° to 47° Baume. An allowance to

We have thus, as it were, wandered around the confines of this immense subject, submitting some facts and inventions, and recording some experiences, which, we hope, may elicit thought and convey information. This sketch contains enough to prove that everything necessary for our wants is supplied at the proper moment, and often in a manner most unexpected. If it unfortunately adds proof of the cupidity of some, it also honors the invention which increases the wealth of the nation without detracting from its honor.

JAPANESE AND CHINESE NEWSPAPERS.

AMONG the many startling innovations on old customs in Japan, none could be more interesting than the last, which consists in the establishment of a Japanese newspaper. This adventurous pioneer of a coming era, and herald of a power hitherto unknown either in China or Japan, is called, says the Pall Mall Gazette, the Daily Hirakana News, or, in the vernacular, *Mainichi Hirakana Shunbunshi*, and is sold in Yeddo at 150 cash (say threepence) by the Society for the Dispersion of Darkness. We learn from the prospectus that the society has a two-fold object: first, to contribute towards the enlightenment of the country by giving its women and children a means of reading government proclamations and home and foreign news; and, secondly, to demonstrate that the use of the fifty syllables is amply sufficient for literary purposes, and that no loss will be suffered by the abandonment of the borrowed Chinese characters. Both objects are excellent, and their promoters, it is to be hoped, will meet with liberal support and encouragement in their own country. The second is a first step towards getting rid of one of the greatest impediments to advancement and to anything like general education—the acquisition of the Chinese language, to the Japanese as much a foreign language as Greek or Latin to modern nations, and far more difficult to master. The Chinese themselves spend the first twenty or twenty-five years of their lives in the work of learning to read and write many thousand hieroglyphic characters. It is as though the whole period devoted in Europe to education at school and college were given to learning an alphabet: for, although it is not necessary that the Chinese student should know all the forty-odd thousand characters which represent the language—and in practice few of the learned know familiarly more than eight or ten thousand, while three thousand may suffice for ordinary official work and correspondence—they do not the less spend all their probationary period before taking their degrees in this comparatively barren labor of mastering the key merely to further knowledge. They only secure this together with the Confucian system of ethics and philosophy—if such comprehensive terms may with any fitness be applied to the whole body of Chinese classics. The

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the buyer of ½ per cent. for every ¼ degree above 47. Refined petroleum must be standard white, or better, with fire-test of 110° F. or upwards. Naphtha must be prime white and sweet; specific gravity 68° to 73° Baume."

Hirakana of the Japanese is a much simpler mode of writing, and is not ideographic in the proper sense of the term. Some fifty syllables constitute its elements. Hence there is an enormous gain in using this rather than the Chinese characters, with their cumbrously antiquated and multiple forms, as a medium for communicating modern ideas and scientific knowledge. Hitherto neither China nor Japan has possessed a newspaper, although in both printing has been in use by means of carved wooden blocks for ages. The letterpress of the Daily Hirakana News is printed with moveable types, the greatest of all innovations and improvements in the art of printing in China. A distinct space is left between each word, and the use of the comma and full-stop is introduced. Foreign proper names and names of places, titles, &c., are italicized by a line or two lines, the meanings of which are explained.

It may be interesting to our readers to know something of the contents of the first number. These consist of a notification from the finance department concerning the collection of the land tax, a proclamation from the government announcing the permissive export of saltpetre under an *ad valorem* duty of 5 per cent.; another touching the manufacture and packing of silk—a subject much discussed lately by English merchants in China, whose interests are materially damaged by imperfect reeling and careless or false packing. Then follows a census of Tôkiô, and an account of a recent gale at Tôtômi. The items of foreign news are curious in their selection for the information of an awakening Japanese population. The first refers to the pope having refused to receive an ambassador from France, and to M. Thiers having been displeased in consequence. The changes in the French ministry are noted, and the illness of the crown prince of Germany; also the gift of 1,000 thalers by the emperor to the sufferers from some inundations. Then a notice follows about the railway fares in Germany, which are said to have been raised by order of the government to prevent emigration. Now that the Japanese have railroads of their own, they naturally may take some interest in their management under other governments. Rinderpest, it is announced, has broken out at Shanghai; and the government of China is said to be building men-of-war, the number and size of which are particularized. The news of the death of the king of the Sandwich islands is given, and an account of the speech of an American minister in favor of the annexation of the islands to the United States, suggesting that the absence of the English and French ministers and the presence of an American squadron affords an opportunity of taking unopposed possession. Their own former experience of Commodore Perry's visit as the United States plenipotentiary, and the sole representative of any foreign power, with a squadron to back his diplomacy, may no doubt lend a certain interest to this account of what is passing at so distant a place. As the editor is himself a Japanese, it may be assumed that he knows what items of news will be interesting to the bulk of his countrymen. The paper closes with advertisements, in themselves an interesting study.

The same mail brings information of a similar movement among the Chinese emigrants in California, and it is announced that "a Chinese newspaper is to be started in San Francisco. It appears that the six Chinese companies in that city have clubbed together and determined upon this enterprise, and a Pacific mail steamer took out an order from them for 1,000,000 types—Chinese characters—to be used in stocking the office. Their plan is to publish the paper three times a week, its chief object being to instruct their countrymen in their own language as to their rights and wrongs from the time they land on American soil. The first number is promised in September." Such movements as these in both hemispheres—among the Chinese on the Pacific coast of the western continent and the Japanese at home—are significant facts, and may issue in some important consequences one day.

182658

MINING AND METALLURGY.

[This Department is under the editorial charge of THOS. M. DROWN, Analytical Chemist and Consulting Metallurgist, Philadelphia]

IT is an idea that has frequently been suggested that the best form for a blast furnace is that which is assumed by the furnace in good, regular working. In other words, we should take a blown-out furnace, within certain limits, as our model in constructing a new one. This subject has recently been brought forward anew in a late article in Engineering, in which the forms of some of the well-known Styrian furnaces are discussed, from data furnished by the Vienna exhibition. It is questionable whether iron metallurgists have rightly interpreted the indications that a blown-out furnace affords. The intense heat in the hearth of the furnace, together with a cinder more or less basic, causes naturally a gradual destruction and widening of the hearth. If the furnace works better as the hearth grows wider, it is certainly a very plain hint that a wider hearth is called for on rebuilding. This widening of the hearth under working, however, is to be regarded as an incidental result. It is, moreover, not an alteration of outline—merely an increase in diameter. The boshes of the furnace being exposed, not only to a high temperature, but also to the abrasion of the descending materials, are gradually worn away, and we have as an end-result a more or less continuous line from the bottom of the hearth to the top of the boshes, annihilating the angles and proportions which may have been the result of long and careful study.

But the working of a furnace depends fully as much on the construction of the upper part of the shaft as the lower, and on this point we get no hint from a blown-out furnace, as the outline of the stack from the boshes upward seldom undergoes any change. The indications we derive, therefore, from a working furnace as to the best and natural outline are confined solely to the lower half. These indications may be summed up as follows: The lines of the furnace should correspond to the diminution of the charge, in bulk, in descending. This change is gradual, though not uniform, throughout the whole furnace, and the lines of the furnace should, in any given section, be made to correspond. There seems to be no reason why we should not apply this reasoning to the upper part of the shaft as well as the lower, and make the whole outline correspond to the changes which the charge undergoes in descending. The diminution of bulk begins as soon as the heat is sufficient to enable carbonic oxide to act on oxide of iron. The decrease is naturally more rapid the lower the charge sinks in the shaft. A furnace, therefore, with walls expanding to a point within a short distance of the top, terminating in a cylinder, would appear to present the outline most favorable to a uniform and regular descent of the charges. Another advantage of this construction, and one of great moment, is that, as the diameter of the shaft increases in ascending, the current of rising gases is retarded and retained longer in the furnace, thus being more completely utilized by longer contact with the ore.

——How often in each decade may we expect the invention of the direct iron process to supersede the blast furnace. The latest instance comes from South Staffordshire, where the inventors "take the ore, grind it to powder, and mix it with powdered lime, together with powdered (*sic*) pitch and tar." This mixture is dried in a kiln for a few hours, and then heated in a furnace for half an hour, and the thing is done. A little squeezing and hammering, and we have the finished bar. From this iron, steel can be made as cheaply as cast iron, &c.

——A HOME Chainaman's views of metals and his metallurgical ideas are as curious as any of his other mental characteristics. His practical skill appears at the best in the production of alloys. Copper is regarded as more friendly to the human constitution than iron, and the former metal is preferred for the making of cooking and washing vessels. Steel needles dipped in a solution of sulphate of copper have been sometimes sold to foreigners as curiosities in the way of well-tempered metallic copper. Although aware of this decomposition of one metal by another, the Chinese have misunderstood it, and they have been led into the assertion that one metal undergoes conversion into the other. The black oxide of iron dissolved in vinegar was formerly employed by the Chinese as an ink. The characters were written with this solution, and the pencil, dipped in the ordinary Chinese or India ink, was used to trace over the characters on the other side. The red sesquioxide of iron is made on a large scale by heating impure sulphate of iron to a great heat. The hotter the fire the better the color; so the *Pen Ts'au*, the manual of chemical manufacture, says. A preparation of great beauty, called *Tieh-haw-fen*, is made by acting upon sheets of iron with vinegar. Lead is scarce in China, comparatively. It is spoken of as the "black metal," and is regarded as masculine, and the progenitor of the five principal metals. Lead, zinc, antimony, and pewter are not carefully distinguished. Formerly, Persia sent lead, zinc, ores of silver, and amalgams to China. Argentan, or German silver, called *Pek-t' ung*, is an alloy of copper, arsenic, and zinc, largely prepared for use in making tobacco pipes. Mercury, called "water silver," the equivalent of the Latin and Greek names for quicksilver, has had a mysterious attraction for the Chinese alchemists. Cinnabar, the most frequent ore of mercury, is also made artificially on a large scale in Hankow and other places, by fusing a mixture of sulphur (two catties) and mercury (one catty), and subliming it. To give a sample of Chinese philosophy, it may be observed that one author quoted in the *Pen Ts'au* says that by the absorption of the spermatic (or *Yang*) principle, a crude matrix is produced, which in a period of 200 years becomes pure cinnabar. This, in 200 years, becomes lead; in 200 years more it is silver; and in 200 years more of gestation it becomes pure gold.

——THOUGH rather a matter of chemistry than metallurgy, we present Ant. Mascazzini's method of assaying lead ore, viz.: The ore or other substance is oxidized, and its metals converted into sulphates before reduction; the best agent for this purpose being sulphate of ammonia. The ore is mixed with an equal or double weight of sulphate of ammonia, according as it is supposed to be poorer or richer, and the mixture is ignited in a small crucible of porcelain, covered to prevent spirting. The mass, when cold, is treated with boiling water, acidulated with sulphuric acid and muriatic acid. By this means the sulphates and oxides of iron, copper, &c., are dissolved, while the lead and silver remain insoluble. This portion is washed by decantation, the washings being passed through a filter. This filter is next dried, and its ashes added to the dried insoluble portion. It is then mixed with muriatic acid and powdered zinc, in order to reduce the sulphate of lead and the chloride of silver. The metallic deposit is washed with water which has been boiled, or acidulated with sulphuric acid, and is then pressed into a compact mass. This is dried and heated with from 1½ to 2 parts its own weight of a flux composed of 13 grammes carbonate of potassa, 10 grammes carbonate of soda, 5 grammes of melted borax, and 5 grammes of farina. The whole is covered over with dried chloride of sodium, and the heat is raised by degrees to redness. When the whole is in a state of quiet fusion, it is submitted for a moment to a higher temperature. This process serves for determining lead and silver in white lead, red lead, ores rich in gold and silver, also antimony, tin, and copper. If, in the assay of ores of gold and silver, the amount of lead is insufficient, pure oxide of lead is added.

——THE American Institute of Mining Engineers, at its last meeting in May, in Philadelphia, extended an invitation to the Iron and Steel Institute of Great Britain to hold one of its meetings of 1874 in this country. A cable dispatch from Liege, Belgium, where the British institute is at present holding a meeting, announces that the invitation has been accepted, and that Philadelphia has been designated as the place of meeting. The importance of this circumstance to intelligent iron metallurgists and to the country at large will be fully appreciated. The American institute is to be congratulated on the consummation of this happy event.

——THE following statement of the sources and uses of tungsten we translate from *Grothe's Allgemeine Deutsche Polytechnische Zeitung*, through the *Berg und Huttenmännische Zeitung*:— For the last eight or ten years tungsten has been used for improving the quality of puddled iron and steel, as well as cast steel and cast iron, in the manufacture of Mushet's "special steel," to toughen German silver, and for making alloys with gold, silver, lead, etc. In many instances the use of this metal is kept secret. The commercial sources of the metal are enumerated as follows: A powder with 72 per cent. of tungstic acid or 59 per cent. of tungsten, purified for addition to steel costing four to five and a half thalers per hundred-weight; North American ore with 74 to 76 per cent. of tungstic acid, sometimes containing tin, of which the best varieties are used in the preparation of steel, bronze, and "mimargent" (100 parts copper, 70 nickel, 5 tungsten, [illegible] aluminum); English ore with 80 per cent. tungstic acid, contaminated with arsenic and copper, costing only three to four thalers per hundred-weight. Purer products come ground and washed from Cornwall, at five and a half to six and a half thalers; Redruth furnishes a product with a large amount of copper, costing twelve to fifteen thalers. From Limoges, in France, there is obtained a product, formed by heating the ore with tar and coal, containing 72 per cent. of acid, at twelve to fifteen thalers. Bartels, in Hanover, furnishes a great number of preparations of tungsten for dyeing and printing. Tungstate of soda serves as a substitute for salts of tin, for rendering fabrics fireproof, for preparation of bronze, blue carmine, tungstic acid, ink, and for cosmetics, instead of white lead or white zinc. Tungsten steel retains magnetism longer than ordinary steel, and is therefore frequently used for telegraphic apparatus.

——PUDDLING by means of the escaping gases of the blast furnace has been successfully accomplished at Savignac-Lédrier, in France, by Langlade's process. This consists in first washing and cooling the gases, in order to condense the greater part of the moisture they contain and remove the greater part of the dust, and then using the gases in a regenerative furnace. The process has now been in regular working since February, 1871, with uniformly favorable results. The gases leave the furnace at a temperature of 150° C., and enter the regenerators at a temperature of 15° to 20° C., having given up the greater part of their watery vapor. Their composition is constant and their pressure uniform. They are so far freed from dust that the regenerators require cleaning only once in nine months. The temperature attained is much higher than in the ordinary puddling furnace, and can be readily regulated. The labor of puddling is much easier, the puddler has much less to do, as he has no firing to attend to, and can therefore devote his whole time to the iron in the furnace. The production of the furnace is high; 14 to 16 charges of 210 kilogrammes (4 cwt.) can be puddled daily. The waste is less than usual, and the iron is never burnt in balling. One thousand kilogrammes bar iron are obtained from 1,200 kilogrammes gray pig iron; whereas, in ordinary puddling, 1,300 kilogrammes are used. The blast furnace at Savignac produces daily 2,500 kilogrammes (24.5 tons) pig iron, and furnishes gas sufficient to puddle 3,000 kilogrammes (29 tons), so that we might expect a blast furnace producing 5,000 kilogrammes (49 tons) would yield gas enough to supply two puddling furnaces and a heating furnace besides. This use of blast-furnace gases is, of course, only applicable where they are not needed for steam power to furnish the blast.

——THE Siemens-Martin steel process consists essentially in first melting a quantity of pig iron to form a "bath," and subsequently adding to this bath wrought-iron or steel scrap, which has previously been heated to redness. It is evident that the product in this process is dependent on the purity of the materials employed, particularly the pig iron. Elimination of impurities in a melting-pot or hearth belongs solely to the imagination. Mr. James Park, Jr., of Pittsburgh, has patented a process whereby he produces steel in a similar way to the Martin process, but, using only substances of great purity, his product is a steel of the best quality. He takes blister steel containing, say one per cent. of carbon, and melts it in a crucible. When melted, an equal quantity of wrought iron, previously heated, is added, and a steel obtained containing 0.5 per cent. carbon. This addition of wrought iron may be continued even to the point of the formation of soft iron, if desired. The process may, of course, be performed equally well in an open-hearth furnace. Although the patent bears the date of 1867, it has only recently been published.

——Messrs. Smith & Williams, of Middleborough, England, have patented a process which would, if all they claim for it be true, "revolutionize the iron industry of the world." Their process is not essentially new; it is merely a revival of an old idea in a new form. It consists in blowing superheated hydrogen, formed by the action of superheated steam on incandescent coke, into the furnace through the tuyeres. From a somewhat imperfect sketch of the process in Iron, it is not clear whether the gases resulting from the distillation of coal are likewise blown into the furnace, but we infer this is the case. Among the claims that the enthusiastic inventors make for this method of producing heat in the furnace are, first, a reduction of 11 cwts. of coke and 8 cwts. of limestone per ton of pig iron. Second, an improved quality of metal: (of course, no new method ever failed to eliminate impurities; the simple and implicit faith that most people have in the ability of hydrogen to carry off phosphorus in the blast furnace is rather remarkable, considering there is not a single fact to support it.) Third, a saving of first cost, no blowing machinery being required. Fourth, an increased make of iron. It is difficult to see why the inventors did not so far perfect their process as to do away with all the coke in the furnace. The best antidote to visionary schemes of this character is a careful perusal of Bell's studies on the blast furnace.

——There is a touch of silver excitement in the Arkansas valley, C.T. Prospectors declare that they have struck it rich. Some of the gold ore assayed (average samples taken from the width of a vein) with the result of four ounces gold and two ounces silver per ton. On veins at the head of Iowa gulch, from a crevice six feet wide, ores containing from forty to fifty dollars per ton, and of which large quantities are extracted, are thrown into the waste dump, the grade being too lean for present working; the mountain slope is so steep as to require a strong, substantial platform for everything to be retained. A lode near Sheridan peak bears somewhat promising indications. For several weeks this side of the range has been thoroughly gone over. Some parties settle down to work on the first vein found, while others keep going, expecting to find bullion in mass and position.

——Uniformity in steel is well nigh unattainable by any process of manufacture. Careful examination and sorting must supplement the melting where nice distinctions are to be maintained. This is notably the case in the preparation of steel for boiler-plates and other purposes where strength and tenacity are of prime importance. Messrs. Bolton & Pedder, of Pittsburgh, have recently patented a process for the conversion of plates which prove to be too hard for boilers into soft steel, which is adapted for this purpose. It consists simply in heating the plate in contact with oxidizing substances below the point of fusion, precisely in the manner in which malleable castings are made. The time of exposure to the heat depends on the amount of decarburization to be effected.

——Recent experiments to determine the strength, etc., of phosphor-bronze, all tend to prove the remarkable properties that have been claimed for this alloy. The following data are from experiments made at the Imperial arsenal, at Vienna, by Col. Uchatius:—

	Absolute resistance, lbs. per sq. inch.	*Point of elasticity.*	*Elongation, per cent.*
Phosphor-bronze	81,795	54,915	1.6
Krupp's cast steel, as used for guns	72,258	14,450	11
Ordnance bronze	31,792	5,562	15

——Wood screws of Bessimer steel are now a regular article of manufacture at the Union works, at Cleveland, Ohio. These screws are said to be remarkably tough, and will bear from two to three times more strain than the best iron screws in the market. The process of annealing, by which the steel-rail ends are made suitable for screws, is at present a secret.——Danks's puddler still continues in favor in England. The Erimus iron works, Middleborough, are being constructed to make iron exclusively by Danks's process, and Messrs. Hopkins, Gilkes & Co. intend erecting ten additional furnaces. The same firm are also constructing a patent cupola to melt the iron previous to running it into the puddler.——Three new flowing petroleum wells have recently been struck in Butler county, in the Pennsylvania oil region. One is a 1,000 barrel well, another 1,300, and the third 1,500. Prices of the crude oil have fallen to $1.10 per barrel in consequence.——It is probable that Mr. Ferrie's patent self-coking furnace-top will be adopted at the Etna furnace, now building at Ironton, Ohio.

INSURANCE.

STATE insurance supervision is up for debate; and the question in relation to it is not what it should be or do, but whether it should exist. Considering that the quality of such supervision as we have is not of the best kind; considering, too, how much easier it is to criticise than to perform; considering, further, how Milton's Satan found the administration of the heavenly kingdom very inferior to what it would have been had he himself had charge of affairs, it is not surprising that such supervision gets many verbal raps, against which it is defenceless, and is forced to admit a deficiency which impairs the capital of its utility. Still, government oversight of insurance is in no danger from such rhetorical animosity; it has outlived much more than this. It exists despite of the once almost universal laudation which made it infallible and absurd; it exists despite of superintendents and commissioners—despite of the legislative bounty of power which made it irresponsible and despotic, and thereby corrupt. Even Millerism and the National Convention reciprocal general insurance law did not kill it. Instead of being inimical, circumstances make the voluble hostility an aid and service rather than a detriment.

We affect State supervision—moderately; never had it very badly on the brain—have not, therefore, caught the fever of the present anti-department mania. We have said, at different times, in different forms of words, that State supervision is a good thing—in its place; we have had to note more frequently that it strongly inclines to get out of its place, and if the castigations it is receiving help to keep it where it belongs, no friend of the proper exercise of the State relation to insurance will object.

Much of what is said in antagonism to State interference in insurance, simply as a branch of trade, we heartily accept. Our political theory is, that that government is the best which governs the least—the least that will secure the harmony of the general interest in the collisions of individual selfishness. Whenever an insurance statute is part of the now superabundant over-legislation, its result is evil, and it is condemned by the sound principle that the creation of a new statute can be justified only when it is called for by a commensurate necessity.

The State relation to insurance has never been defined. This is owing to the fact that the State department has been an experiment with the right functions to be determined by actual trial, and the administration thereof has drifted from one conjecture to another, as commissioner or superintendent trying to solve his perplexities has called for law upon law, forgetting or not knowing that arbitrary regulations are not economic forces.

In the United States, with the single exception of the marine Lloyds, the underwriter is a corporation, and this at once places the State authority in a different connection with the interest from what it would have been were the underwriter a person. The underwriter is a public corporation in a larger sense than those incorporated mercantile and manufacturing unions which are mere special partnerships, whose members are carrying on a business which they could conduct in their personal capacity without the corporate franchises. So far is the essential corporate character of insurance made a rule in Pennsylvania that there is among the existing statutes of the State one prohibiting, disallowing, the personal underwriter, in respect to fire and lightning insurance.

Insurance is therefore conducted upon the responsibility of a corporation, which corporation derives all its rights from the State, and has its line of being and acting marked out, by which it is just so and does just so, and cannot legally be or do otherwise. The franchises, however, once conferred, are sacred, and, unrepealed, cannot justly be impaired by State action—*i. e.*, without the State authority passing what should be its constitutional limits. Therefore, within the circle of its tether, the management of a corporation should be free—possessed of all the freedom of the citizen. Still, it is tethered to its charter conditions, and the State can with propriety know, *ought* to know, that the considerations upon which the privileges were granted are fulfilled. The State creates a corporation to be responsible for insurance contracts, for such responsibility is involved in the right to make them—shall not the State exact the responsibility and have evidence of it? Does it not morally guarantee such responsibility? The State gives no such guarantee of the financial ability of the personal contractor; hence the exemption of the latter from interference, and hence his comparative, unvouched irresponsibility. Further, in mercantile and manufacturing corporations, the transactions are carried on by funds furnished by the stockholders; their funds alone must make the capital basis. They are risking their own money. In insurance the contributors to the real capital are the public with its premiums, and as the public does its share in building up the corporate responsibility, the State should look to it that the work of the public be not despoiled. Whoever purchases goods from either class of non-insurance companies named, has the evidence of the value of his purchase before him; whoever buys insurance, can judge of the value of what he buys only by such a series of requisite and related facts as in all insurance experience the State alone has secured and made public. We will say, however, that when any corporation contracts a common debt, not an obligation of its technical character, that its creditor should have no vantage ground (except that which is inevitable) over and above the position of the creditor of a citizen, as he has been enabled to exact such special security as he deemed necessary, while the insurance policyholder must at best depend upon the general trustworthiness.

State control over a corporation, however, gives no control over its business as such. If a State gives a company a right to issue insurance policies, we do not conceive that the State itself should issue those policies, or any part of any policy. The safety of the company and its funds depend upon the way its business is managed. If the State manages the business in part, and a loss thereby occurs, a great wrong without remedy is done to the company, by the rule that "the king can do no wrong." As the company insures, not the State, the company is the underwriter, and not the State department: and the meaning of this is, in regard to State superintendency, that while the department may overlook the underwriting, it cannot direct it; while it is done, so to speak, in the sight of the department, it is not done under its orders. Hence no properly constructed and administered State department will usurp what are the exclusive functions of a company, nor attempt such an impossibility in its case as the regulating of the insurances.

The department is the executive instrumentality of the statutes; but the statutes cannot consistently enlarge the proper sphere of department action. Discretionary power, subjection to the vagaries of official caprice, belongs to Asiatic despotisms, not law-governed peoples. The positive work of a State bureau intervenes simply at the financial side of a company, and even here should not encroach upon established business usages. On points really affecting the financial position or the financial results of the transactions, the broadest range of inquiry is allowable—is demanded, and the questions should be in connection with all adequate means to test the accuracy of the answers; but the line of investigation should be defined—not only to secure impartial treatment of the companies, but they have a right to know what conditions they are to comply with. Even here the principle of non-interference in the mere carrying on of the business should govern; and when a department descends to the *details* of management expenses (excepting as necessary to verify the general account), it is guilty of an impertinence—which is useless as a test—and may obstruct work that the management deem advantageous. Of course, it is necessary to know the cost at which insurance is conducted—the managing expense; but how the moneys are expended is no part of such information. As a question of extravagance or economy, the nearer solution is found in a comparison of the companies; but even here the merits or demerits of such outgo depend more upon the results attained than the relative percentages. Perhaps a classification of this part of the outgo into the office and the agency expense would reach the end sought.

Our conception of an insurance department, therefore, eliminates as far as possible all communism, all control of individual affairs by a government bureau. We don't think very highly of the kind of government which can, for example, in consistency with its administrative theories, set up a huge national tailor-shop to make every man wear a certain style of dress, or with or without the tailor-shop, exact that each person shall spend a certain sum of money each week; or, what is the same in principle, substitute its judgment for a man's own judgment in a business transaction. A commission of inquiry and record fulfils the duties of a department, which is the consummation of a law that demands evidence that its provisions have been complied with—the substance of the same law being a standard and a statement. With greater latitude a State bureau will be found to outrun its usefulness, and run into theories which it may take some years to explode; meantime working great injury, even to the closing up of companies which might be saved. We have doubts even of the value of the power by which a department, either directly or at its instance, shuts up a company or excludes it from the State. As a general rule, insurance companies die fast enough with or without such departments, and when a company had previously given proof of its right to live, its violent dissolution in its impaired condition does not turn out beneficial to its creditors. A penalty other than dissolution should be inflicted when a company, found short of the standard, continues business without making up the deficiency, and it would be more just to imprison the managers than to wreck the institution. With a competent State official simply disclosing the stages of a company's decline, it could depart decently and in order.

Of the facts ascertained by the official inquiry there should be full publicity, and as there may be some delicate points, regarding which no good could be served by public notoriety, the knowledge of them should be kept from the department. Though the verification of a company's returns necessarily brings information not within the compass of a periodical statement, yet, as a rule, the State official should know nothing not for the public to know. A commissioner or superintendent going in and out of an insurance office, with secret knowledge that places the fate of the company in his hands, is a spectacle which requires words to describe that we shall not employ here. It is sufficient that there is too much money in the situation for wrong purposes, if not enough for right ones. Doubtless all State insurance officers are honest men—in the simplicity of our heart we believe all public officials are honest—but, then, it is well to keep them—from temptation.

Its statistics are the best part of State supervision. With some qualification, it might be said that, outside of its statistics, present departmentalism is a failure—though less so now than in the past. There is a great range of usefulness in the improvement of its statistical work—so great that, enlarged in scope, not objects, and redeemed from chaos, it is possible that here will ultimately be found the key to what is yet locked away in the obscurity of the unknown—namely, insurance solvency. We can see no guidance in insurance affairs, no progress in the application of the principle, not even intelligent discussion, if deprived of the data which the instrumentality of the State alone can furnish. The average editorial verbiage—two grains of thought or fact to the bushel of words—is certainly a wretched substitute for such information, imperfect as it yet is. A State insurance census and registration is as practicable as State regulation of insurance is visionary and harmful, and an adequate statistical bureau will come nearer the object in view than a vaguely inquisitorial, ill-informed, intermeddling, theorizing,* business-disturbing authority can ever attain to. Perversions of the State relation to insurance being popular, had necessarily to run the length which reaches to reaction. That end is at hand; the flatterers are turning to defamers; the idol is falling in the midst of its worshippers; let a fairer statue arise in its place, which, if it shall not, like the first, secure the glowing homage of a blind, adoring faith, will yet be sure of the just appreciation of the cultivated perception and the reasoning judgment.

A word on the proposition to substitute a federal central bureau for the present State departments may be appropriate as we close. As a proposition it may be worthy of investigation, but the discussion relating to it must take a different direction from what it has taken. The corporation-making power of the federal government is very limited, and we do not see how its jurisdiction can range beyond its creative authority in this respect. Right in face of the movement stares the incongruity of *national* supervision over *State* institutions. Even if the companies were all under District of Columbia charters, the national bureau could not over-ride the sovereign power of each State to make its own insurance laws. Hence uniform legislation, the object of a national bureau, can be secured only by concurrence of the respective States; and so the problem of uniformity is left just where it is, as an affair between States, even with a national bureau. It is important that insurance, which is really a national work in its best operations, should not be hampered by merely local peculiarities; but the way to get rid of such is really more *direct* by a national law which is the expression of inter-State comity, than by any federal agency.

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* We do not object to department theories as such. Theorizing is a useful, perhaps necessary expedient, for an advance in knowledge, but to force the theories upon the companies as imperative rules is nothing less than all outrage.

——WE have received proof-slips of the life report of the Missouri department, dated June, 1873, and make the following abstract:—

There are six companies in Missouri in active prosecution of business: three—the Covenant Mutual, Life Association of America, and the German Mutual—being purely mutual, without stock or guarantee capital; one—the Mound City—recently changed from stock mutual to a simple proprietary organization; and two—the St. Louis Mutual and the Missouri Mutual—being mixed, or having paid-up capital stock and doing business on the mutual plan. Forty-six companies of other States, including the Railway Passengers, also do business in Missouri.

The amount of life business done in the State is not known: as near as can be ascertained—*i. e.*, according to the figures gathered—it was as follows: (Superintendent Selby says "about one-third of the companies [of other States] seem to be afraid to show what they do in the State.")

	New policies, 1872.	*Amount insured.*	*Premiums received.*	*Losses paid.*
Missouri companies..................	3,545	$6,601,544	$1,333,363	$338,826
Other-State companies..............	4,136	8,241,596	1,447,357	703,013

The incompleteness of these returns, as respects other-State companies, is manifest at a glance. It is just as probable that the other-State companies did 42 per cent. less business in Missouri than in Michigan, as that nearly one-half of the Missouri premium was paid for Missouri losses.

The Missouri companies have of assets in possession, $11,552,270.80; of admitted assets, $12,840,312.51. The aggregate reinsurance reserve is $11,098,024.00, and the aggregate liabilities are $11,859,916.47. They had last year an income from—

Premium receipts	$6,177,836 82
Interest "	695,809 02
Miscellaneous cash receipts..	8,466 78
Total..	$6,882,092 62

They disbursed last year for—

Policy losses and matured endowments..	$1,483,390 10
Dividends, surrenders, and other payments to policyholders..............................	1,340,484 81
Pay account—commissions and salaries..	1,[illegible]4,180 46
Advertising, taxes, and all incidentals..	566,916 56
Stock dividends, interest, &c..	42,916 43
Total outgo..	$4,437,888 36

Their policy account for the year stands as follows:—

In force, January 1, 1872*..	31,787	$121,870,160
Issued and revived..	15,015	46,134,931
Terminated..	13,155	50,940,123
In force, December 31, 1872..	33,647	117,064,968

An exhibit of the business results of the Missouri companies in the last five years is as follows:—

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* Exclusive of the Atlas.

MISSOURI COMPANIES—YEAR ENDING DECEMBER 31.

	Policies in force.	*Amount insured.*	*Annual premium.*
1868	13,940	$ 55,789,540	....
1869	23,512	97,199,979	$4,089,593 37
1870	33,259	131,972,128	4,733,040 90
1871	33,269	130,428,821	4,968,545 63
1872	33,647	117,064,968	6,177,836 82

It will be observed that from 1870 to 1871, and from 1871 to 1872, the number of policies increased while amount of insurance decreased. This lower average of policy sum is in part accounted for by the substitution, under the non-forfeiture stipulation, of paid-up insurance for the original amount of the policy.

Comparison between Missouri companies and other-State companies shows the annexed percentages of returns of annual premium receipts to policyholders in the years given:—

	1869.	1870.	1871.	1872.
Missouri companies	29.2 per cent.	39.7 per cent.	48.1 per cent.	45.5 per cent.
Other-State companies	42.5 "	51.5 "	61.2 "	61.9 "

Death losses and matured endowments alone were, of premiums:—

	1869.	1870.	1871.	1872.
Missouri companies	17.5 per cent.	21.9 per cent.	27.6 per cent.	24.1 per cent.
Other-State companies	18.3 "	21.4 "	23.1 "	26.4 "

In 1869 and 1870 the death-rate was well below the average of the tables in use in this country; in 1871 and 1872 it was in excess of the tabular rate; and for five months in 1873 the mortality among insured lives has been heavier than ever known in this country, except in seasons of general epidemic. This increased mortality has had to be met, and as none of the former mortality gains had been stored up, but had all been distributed, the payments have been made, at the expense of dividends, from other sources.

The ratios of expenditures for procuring and maintaining business—that is, of salaries, commissions, taxes, advertising, printing, rents, State department fees, &c., &., (all expenses except policy returns, stock dividends, and reinsurance premiums,)—to premium income, of the companies now authorized to do business, and which have been in the State at least three years, are as follows:

	1869.	1870.	1871.	1872.
Missouri companies	31.8 per cent.	31.5 per cent.	29.0 per cent.	25.4 per cent.
Other-State companies	19.8 "	18.2 "	18.1 "	17.4 "

——THERE were forty-five life insurance companies (1 State, 44 other-State) doing business in Michigan, December 31, 1872, as shown by the State commissioner of insurance in the third annual report of the department, against fifty-six the previous year. The account of the total State business of the companies in 1872 is as follows:—

	Policies issued.	*Amount insured thereon.*	*Policies in force, Dec. 31.*	*Amount insured, Dec. 31.*	*Premiums received.*	*Losses paid.*
Michigan Mutual...	539	$ 1,284,575	1,949	$ 4,053,127*	$ 137,463 18	$ 19,050 61
Other-State Co.s.....	6,813	14,188,004	27,243	55,588,857	1,829,029 73†	413,155 83
	7,352	$15,472,579	29,192	$59,641,984	$1,966,492 91	$432,206 44

The Continental Life, of New York, issued the greatest number of new policies in the State in 1872, viz., 642; the New York Life had the greatest amount of insurance in force at the close of the year—$9,074,700. The general results of the State business in 1872, as contrasted with those of 1871, show a falling off of 2,804 in the number of new policies issued, and $1,866,686 of new insurance; but a greater amount of premiums, by $141,527.61, was received in 1872. Average of policies issued in 1871, $1,707.29; new policies of 1872, $2,104.54.

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* Total business of this company: 2,357 policies in force; total amount at risk, December 31, 1872, $5,234,861.
† Includes $29,500.87 of six withdrawn companies.

——SUPERINTENDENT Edward Russell issues No. 3 of Kansas insurance annuals very soon after No. 2 of Superintendent Webb. Mr. Russell is evidently no laggard, but his quickness appears to have been fatal to the Home—the Home, of Topeka, and concerning which Home, of Topeka, we find the most interesting part of his report.

This Home, of Topeka, was certified once by the Kansas department, then certified again; but just after the expiration of the second certificate, the new superintendent was propounding conundrums to the Home, which had the same effect as Mr. Macbeth's test questions upon the witches:

> ——and what seemed *corporate*, melted
> As breath into the wind.

Yet, where there is now sable there was once gilt. Mr. Russell tells one story—Mr. Webb told another. We put the two together, not as one tale of two cities, but as two tales of one—company. Each heightens the effect of the other charmingly—or, rather, dolorously. It is to be regretted that tarnish soon darkened the gilding of success which the gilder gave—but, then, *omnia mutantur*. Still the transition is sad, and we see tears trickle down the cheeks of fierce insurance scribes, who, pausing in the rage with which they are "going for" State insurance departments, wail over the doleful contrast, which is thus:—

From Second Annual Report of Kansas Insurance Department, January 13, 1873.

HOME FIRE, OF TOPEKA.

This company complied with all the provisions of the present law applicable to domestic companies in October, 1871, and received from this department a certificate of authority to transact business in this State. On the 11th of January, 1872, the company filed a statement of the condition of its affairs on the 31st day of December, 1871, and has received from this department a renewal of authority for the year ending February 28, 1873. A majority of the stockholders and directors of the Home are among the most prominent and wealthy German citizens of the State of Kansas, and to the well-known conservatism of this class of our citizens may be attributed the fact that the business of the company has thus far been confined to two States alone, while the company's financial condition would justly warrant its admission into a large majority of the States of the Union. The officers of the company are now making the necessary arrangements to extend its business during the ensuing year into several additional States.

The authorized capital stock of the company is $300,000, of which $270,600 have been subscribed. Fifty per cent. of the subscribed capital, amounting to $135,300, has been paid up and invested in the class of securities required by law. By reference to the statement of the company herewith published it will be seen that its total assets on the 31st of December, 1871, were $144,223.42, and that its liabilities, including reinsurance fund, amounted to $17,912.96, leaving a surplus as to policyholders of $126,310.46. Total liabilities, including paid-up capital, are $153,212.96, which makes an impairment of $8,989.54, equal to about 6.6 per cent. of paid-up capital. Eliminating from the assets of the company, as set forth in its statement, several items amounting in the aggregate to $17,802.29, which, under the rule adopted by this department, have been rejected as unadmitted assets, the actual admitted available assets of the company are reduced to $126,421.13, which increases the technical impairment of the capital to $26,791.83, or a fraction less than the maximum percentage of impairment permitted to exist by the law of this State. Considering the recent organization of the Home, and the heavy expenses necessary in placing the company upon a solid financial basis, necessitating the change of investments in order to comply with the provisions of the present insurance law, the officers and directors of the Home may justly congratulate themselves upon the present favorable condition of their company, as shown by its published statement and the good degree of public confidence and patronage it has already obtained.

From Third Annual Report of Kansas Insurance Department, July 31, 1873.

HOME FIRE, OF TOPEKA.

The Home Insurance Company of Topeka filed its annual statement on February 18th, 1873, which received immediate attention, and upon the 21st of February I addressed a communication to the secretary of the company, inquiring—first, as to the nature of the company's mortgage assets, with their accrued interest; second, as to the short loans; third, as to their bills receivable; fourth, as to reinsurance of the State Fire Insurance Company. Receiving no satisfactory information, on the 20th day of March I issued an order to the company, by virtue of section nine (9), page 217, of the insurance law of 1871, requiring that it should, within sixty days from that date, collect all accrued and unpaid interest upon its stockholders' mortgages—most of which had remained unpaid for a period of two years; that it should cause all second liens to be paid or made first liens, and short loans to be paid or properly secured. At the end of sixty days the officers of the company, or the managing ones, made a sworn return, which they claimed to be entirely satisfactory, but which subsequently proved to be wholly erroneous, if not absolutely false. As I still refused to license the company to proceed with its business, the stockholders had to be called together, and a full statement laid before them of the actual condition of the company; when it was discovered that some of them had been deceived by one or two of the principal officers of the corporation into mortgaging their homesteads, under the promise that they should not be called upon to pay either principal or interest of their notes so secured. The stockholders, after finding out from this department the real condition of the company—which was only discovered to us by a careful personal examination made by my very capable and efficient chief clerk, H. Clarkson—promptly, and wisely for them, voted to discontinue business and reinsure their risks, which reinsurance has been effected with the Brewers' Fire Insurance Company, located at Milwaukee, Wisconsin—a company recently admitted to do business in this State. The policyholders of the Home are thus entirely protected from all loss, and all of the company's legitimate creditors will, I think, receive their payment in full, with possibly some slight delay. * * * * *

I can hardly suppose it necessary for me to attempt any defence of insurance supervision, * * * only calling attention to the facts concerning the Home Insurance Company of Topeka, the officers of which professed to hold, and swore to a capital of $165,800, with assets claimed upon oath to be worth $166,566.22; while, upon careful examination, we found the company possessed of assets, at all available for meeting losses within a reasonable time, of only the pitiful sum of $3,096.94—unless the company resorted to foreclosure upon homestead and other mortgages of its stockholders.

Mr. Russell's defence of State supervision, by his illustration, is not altogether fortunate as such; but, then, the defence of State supervision in the department reports is always a failure, not by reason of the subject, but owing to the fact that the advocacy or eulogy is altogether out of place where it is.

——In view of the great financial convulsion and the well-known connection of Mr. Jay Cooke with the National Life Insurance Company, U.S.A., the inquiry is naturally started as to how the life company may be affected by the suspension of the great banking-house. Such inquiry is, however, not likely to be made by those familiar with the National Life's financial construction. Before the present trouble, and when the association would have been deemed a source of strength rather than weakness, the books and asset list of the National exhibited no identification of the life company with the business enterprises of Jay Cooke & Co. The National never held a dollar of Northern Pacific Railroad bonds or stock either as collateral or by purchase, and had no deposits either with Jay Cooke & Co. or E. W. Clarke & Co. The loans of the company are either upon first mortgages or stock and bond collaterals, and the latter are distributed over a great variety of securities, worth in the market to-day at least 25 per cent. in excess of the aggregate amount loaned upon them. The National's present monetary position is summed up in the statement that the assets held July 1, viz., $3,116,275.41, instead of being since impaired, have, on the contrary, been augmented—the mortgage securities being increased $300,000.

——The fourteenth annual report (Part II, life insurance) of the New York insurance department, Orlow W. Chapman, superintendent, exhibits 32 State and 27 other-State life companies doing business in New York in 1872, against 39 of the former, and 29 of the latter in 1871, with one other-State company—the Missouri Valley, of Kansas—newly authorized in 1872. The general condition of the body of New York companies is shown as about equal at the close of 1872 to that of 1871, viz.:—

	No. of companies.	*No. of policies in force.*	*Amount insured.*	*Gross (admitted) assets.*	*Gross liabilities, except capital.*	*Surplus as to policyholders.*
1871......	39	387,365	$1,059,593,408	$150,543,823	$129,218,264	$21,325,559
1872......	32	386,690	1,051,970,818	166,277,986	145,660,891	20,617,094

This outgo of but $708,465 of the surplus excess evinces that the gap made by the weakening companies was nearly filled up by those that advanced their financial position in the year, and is in favorable contrast with the lessening surplus of the Connecticut companies, as presented in our August issue. Fifteen of the New York companies showed a deficiency of $1,256,786 in their aggregate stock capital, while 14 other companies, having stock capital, exhibited a total net surplus of $7,736,079. In the tables of the two bodies of companies—State and other-State—only one company, viz., the Economical Mutual, of Rhode Island, is shown with an impaired reserve, being minus $68,660.10 after absorbing its $100,000 capital. The somewhat notorious Hercules Mutual, of New York, by its returns to the department, claimed $43,321.86 of its capital stock left above liabilities, viz.: Assets (admitted), $128,575.76; liabilities, $85,253.90; but, upon investigation being instituted, the examiners reported for May 9, 1873—assets, $94,025.18; liabilities, $145,433.29 (value of policies, $30,000)—an asset deficiency of $51,408.11; the New York Supreme court dissolved the corporation, ordering a distribution of its effects—*i.e.*, providing sepulture for the corpse, as the Hercules had about reached its end, having received less than $20,000 of premiums in 1872.

The tables of the registry business shows 14,742 registered policies in force, insuring $38,684,752, with a State deposit for the security of the same of $2,833,350, of which sum $1,890,700 are deposited by the North America Life, the originator of the system. By its various tabulations the report covers broad ground, and gives a comprehensive view of the life insurance position, with very probable approximations to certainty. It has, however, the prominent deficiency of not showing the distinctive life business done in the State of New York—respective companies reporting any number of the items from one up to ten, and some none.

Appended to this report is the legislative resolution adopted May 30, 1873, striking out from the "thirteenth annual report" Miller's attempted justification of his administrations with personal attacks upon others, as "believed to be untruthful and unjust," and as "wholly unauthorized and illegal." From the different tables we arrange the following ratios, &c., of the New York companies:—

NEW YORK LIFE INSURANCE COMPANIES—1872.

Commenced business.	Name of Company.	Total amount of policies in force, Dec. 31, 1872.	Average amount of each policy.	Average reserve on each policy.	Ratio of amount of claims to amount of policies in force.	PERCENTAGE OF INCOME PAID—1872.					Applied to reserve.
						For dividends to stockholders.	For dividends to policyholders.	For losses and claims.	For expenses.	For purchased, lapsed, and surrendered policies.	
1866...	American Popular.......	$6,227,174	$2,249	$140	.45	4.82	......	19.93	48.23	4.87	22.15
1868...	Asbury....................	5,482,139	1,976	128	1.22	......	5.28	29.58	42.90	2.60	19.64
1866...	Atlantic Mutual..........	8,450,145	1,943	199	1.50	1.89	3.80	25.73	18.17	15.51	34.90
1864...	Brooklyn..................	11,992,958	2,613	368	1.33	3.45	8.49	19.25	26.03	13.56	29.22
1868...	Commonwealth...........	4,514,379	1,995	115	1.32	5.76	5.06	21.86	36.45	7.38	23.49
1866...	Continental	60,623,390	2,121	184	.91	0.22	9.38	18.05	21.33	17.10	33.92
1868...	Eclectic....................	5,257,365	1,893	92	1.79	......	3.99	41.31	50.48	2.64	1.58
1869...	Empire State..............	4,294,615	1,824	79	1.19	6.75	10.57	20.84	38.36	17.00	6.48
1859...	Equitable..................	171,443,351	3,975	386	.99	0.09	12.89	19.98	16.29	10.43	40.32
1867...	Excelsior..................	6,215,637	2,362	173	1.51	2.58	4.70	20.50	34.53	14.06	23.63
1860...	Germania..................	34,600,263	1,787	231	1.31	1.32	12.27	24.99	15.91	5.81	39.70
1864...	Globe Mutual.............	30,236,185	2,412	273	1.30	0.74	13.40	26.44	20.87	4.29	34.26
1870...	Government Security...	3,503,284	2,563	139	1.19	4.22	0.40	31.63	30.67	23.56	9.52
1859...	Guardian Mutual.........	32,735,940	2,166	231	.97	0.35	6.43	12.98	13.67	13.23	53.34
1869...	Hercules Mutual.........	350,817	1,266	127	1.00	......	......	12.50	89.15	......	......
1860...	Home.......................	21,466,111	2,030	262	1.14	1.44	19.76	23.85	14.66	7.97	32.32
1868...	Homœopthic Mutual ...	4,624,515	1,987	162	1.29	......	3.32	24.49	27.81	18.65	25.73
1853...	Knickerbocker...........	42,739,871	2,700	447	2.17	0.22	14.77	29.89	11.88	32.52	10.72
1850...	Manhattan	42,343,613	3,226	472	1.34	2.32	16.92	26.63	13.93	6.68	33.52
1870...	Merchants.................	1,345,951	1,962	106	.67	......	1.13	11.97	52.52	12.59	21.79
1866...	Metropolitan..............	20,546,341	1,339	78	.80	......	8.08	21.97	24.54	10.44	34.97
1842...	Mutual.....................	264,593,682	3,386	661	.91	......	29.69	15.47	7.63	8.78	38.43
1863...	National...................	7,426,474	1,945	191	1.48	......	0.22	33.50	41.01	33.16	......
1843...	New York	118,622,605	2,877	439	1.27	......	10.45	19.07	12.57	19.81	38.10
1830...	N. York Life and Trust	345,400	3,420	2,445	11.00	......	......	68.38	0.13	11.54	19.95
1862...	North America...........	34,355,676	2,484	372	3.34	......	9.21	62.77	23.14	7.16	......
1862...	Security....................	32,554,062	2,414	224	1.77	0.93	15.58	31.20	21.75	12.86	17.68
1850...	United States.............	22,929,762	2,265	284	1.00	3.14	16.08	18.85	17.25	29.96	14,72
1865...	Universal..................	17,664,986	2,582	129	1.11	2.04	......	25.91	29.52	18.76	23.77
1860...	Washington...............	25,950,890	2,367	266	1.06	0.81	9.09	22.27	18.67	5.12	44.04
1868...	Western New York......	2,566,891	1,426	63	.46	......	9.53	12.90	57.56	4.98	15.03
1866...	World Mutual............	5,966,346	1,666	128	1.24	......	3.20	30.45	43.76	7.49	15.10
	Total N. Y. companies.	$1,051,970,818	$2,720	$367	1.21	0.49	16.67	21.36	15.00	12.85	33.63

——THE Bureau Veritas gives, in its Universal Mercantile Navy List, the following statistics of casualties and wrecks of steamers in all parts of the world during the first six months of 1873, and for the same period of the three preceding years:—

	Six months ended June 30.			
	1873.	1872.	1871.	1870.
ACCIDENTS TO MACHINERY, ETC.				
Damage to engines	144	117	108	78
Leak in boilers	18	15	4	10
Explosions of boilers, bursting of boiler tubes, bursting of steam pipes and of feed pipes, under damaged	9	8	8	9
Leak in bunkers	...	1	...	...
Screw broken or damaged	34	17	15	16
Shaft broken	18	20	18	20
Loss of screw	14	23	16	11
ACCIDENTS TO HULL, RIGGING, CARGO, ETC.				
Damage to ship and cargo	71	16	20	19
Damaged by ice	4	4	22	6
" fire or explosion	21	9	11	3
" collision	210	74	140	95
Ashore or aground, and got off without apparent damage	109	65	71	57
Ashore or aground, and got off with damage and throwing cargo overboard	57	67	63	64
Deck swept	7	7	5	4
Jettison of cargo at sea	6	...	...	...
Strained	1	4	...	...
Put back with cargo shifted	8	...	...	...
Leak in engine-room	1	1	1	2
Vessel leaky	35	35	32	32
Pumps choked	8	2	4	1
Capsized and recovered	1	1	...	...
Stearing gear disabled	11	5	4	6
Loss of rudder	7	8	5	6
" anchor and chain	8	...	8	7
" boats	21	...	...	...
Total accidents	823	499	555	446
DETAILS OF LOSSES.				
Abandoned	1	4	4	1
Sunk	36	36	30	35
Stranded and wrecked	49	35	38	39
Sunk by explosion	3	...	2	...
Condemned	1	...	2	1
Burnt	3	13	12	4
Missing	6	5	3	6
Total of losses	99	93	91	86

The number of steamers inserted in the Bureau's mercantile navy list being 4,335, and the steamers lost during the year being 99, the losses are at the rate of 2.2 per cent.; of these losses 43 were English, 15 French, 10 German, 7 American, 5 Italian, 4 Norwegian, 3 Swedish, 2 Danish and 2 Dutch, and 1 each Austrian, Brazilian, Nicaraguan, and Argentine Republic. One vessel was lost of which no flag was reported. The bureau includes in its list of sailing craft 56,720 vessels, among which there were 1,055 losses during the six months, or 1.8 per cent. Notwithstanding the increase in the number of vessels in each year, the losses are very nearly the same. The fact that only four vessels should be returned as condemned during the entire period covered by the report, shows either a very great laxity on the part of the official inspectors or a surprising strength and durability in steam vessels. It is to be feared that sufficient allowance was not made each year for the wear and tear of vessels, and that if there had been the number of losses might have been still further reduced.

In the list of accidents during the first half of each year since 1870 the variations are considerable. The increase is chiefly in collisions, damages to engines and machinery, and shifting of cargo. The exact increase in the risks is almost susceptible of arithmetical demonstration, as the addition or subtraction of a single vessel plying, say between New York and Liverpool, would increase or reduce the chances of its crossing the path, or striking or being struck by all other vessels.

——MICHIGAN has a laborious and ingenious commissioner, watchful and zealous to extend the usefulness of his department. We do not always agree with Mr. Row, but even when dissenting can admire the general intelligence of his plans, as well as commend the earnest purpose in which they originate.

The most notable portion of the Michigan life report for 1873 is that in relation to "annual balance-sheets," the theory of which is brought into a working process by changing the asset formula of the annual statements. It is fresh ammunition for the battle of the balance-sheet between companies and departments, and its aim is to draw the cords yet more tightly around the companies. Holding the balance-sheet adopted by the National convention, "while of no positive harm," to be useless as a test of progress or accounts, Commissioner Row remodels the convention form of statement so as to comprise "a balance-sheet of the realized assets," which shall at the same time exhibit the true standing of the company, and cause it "the least possible inconvenience consistent with the end sought"—on which subject of inconvenience we remark, in passing, departments and companies are apt to hold very opposite views. By the change certain discriminations are made in the asset items shaping the statement of them into an attempted corrective of misrepresentation in income returns, making distinctions which do not rest upon values of properties reported, and adding to the assets excluded from offsets to liabilities; and as several companies have even their generally admitted resources close up to the liabilities, the new ruling becomes a serious question to them. We illustrate the effect—or what is made to be the effect—of the reconstructed statement in the case of the Equitable Life, of New York, in comparison with the reports of other States, viz.:—

	Admitted assets.	*Rejected assets.*
New York	$19,160,528	$443,775
Kentucky	19,222,394	381,908
Ohio	19,024,403*	577,899
Michigan	18,658,215*	946,088†
Connecticut	19,276,173	

Following the general idea of the convention statement, the Michigan department makes three divisions of the assets, viz.: Net or ledger assets; unrealized or contingent assets; items not admitted. Realized income (as construed), less disbursements made the standard of the year's acquisition of ledger assets.

We cite from the balance-sheet exposition of the report as follows:—

> Convinced that an erroneous system of accounts led to the practice of reporting uncollected and deferred premiums and accrued interest as *premiums and interest actually received*, thereby decreasing the ratio of expense to income and creating sources of irregularity, a balance of net or ledger assets became a necessity. Such blank form was used by all the life companies reporting to this department. Quite a number of companies returned the statement with no erasures or interlineations, and showed an exact balance; their systems of accounts being apparently in perfect accord with the form. The statements of many were returned for correction and completion, entailing a large amount of correspondence, owing to the peculiar manner in which the ledger accounts were kept.
>
> Although perfection is not claimed for this form of annual statement, it is believed to be based on sound principles, and that its adoption—with a system of accounts in harmony—will result in benefits to all concerned, and relieve the legitimate business from the damaging imputation that it has intricacies and practices which will not admit of exact annual balances.
>
> At the close of each year an intelligent exhibit of the actual transactions during the year and of

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* The sum of $197,991, rejected from amount loaned on collateral. "From loans on collateral, $197,991 were taken and placed with agents' balances, the same being designated as 'balances of agents' accounts secured.'" *Vide* Michigan Report, p. xxx.

† Including $575,591.47 returned as "cash in course of transmission, (and subsequently collected,) such sum being classed as agents' balances."

the realized *bona fide* assets is manifestly due to the public. Not only is the policyholder entitled to know that the funds are in possession, but he should also be advised by the company how the money was obtained, for what disbursed, and the character of the realized assets to balance. Any system of manipulating figures which prevents such an exhibit, or leads to irregularities of any description, is a legitimate subject for criticism, and demands reform.

The business of life insurance has reached a crisis that demands the most visible evidences of integrity and soundness,—a time when the assets actually realized and in possession and those abundantly secured should be carefully winnowed from the chaff of expectant assets. If income is debited with only sums *actually received*, the principal disturbance with the balance would be removed. The term "ledger assets," used in the form of annual statement, embraces such assets as are actually in possession or were properly placed in the category of ledger assets, viz.:—

Cost value of real estate.
Loans on bond and mortgage.
Loans secured by collaterals.
Loans in cash to policyholders on this company's policies, as per schedule on file.
Premium notes, loans, or liens on policies in force, reserve in excess of all indebtedness.
Cost value of bonds and stocks owned absolutely.
Cash in company's office.
Cash in banks.
Bills receivable.
Agents' ledger balances.

To the above was also added, in order to arrive at the custom of the company in keeping ledger accounts:—

*Furniture, fixtures, and safes at cost.
*Commuted commissions.

The above to compose the net or ledger balance, and in contradistinction to contingent or unrealized assets, composed of items of—

Interest due (but unpaid).
Accrued interest.
Rents due (but unpaid).
Rents accrued.
Market value of real estate over cost.
Market value of bonds and stocks over cost.
Net amount of uncollected and deferred premiums.
[Deduction of 20 per cent. for loading.]

Items not admitted as assets.

Loans on company's own stock.
Company's own stock.
Judgments, and 50 per cent. of furniture and fixtures.
Commuted commissions.
Cash advanced to, or in the hands of, officers or agents.
Agents' balances.
Loans on personal security, indorsed or not.
Bills receivable.
Supplies, printed matter, and stationery.

[In these schedules there is no place for amount "due from other companies for policies reinsured;" yet, in the example of his balance-sheet, the commissioner assigns such item to contingent assets as does the convention blank; but in its dealings with the Guardian Life, of New York, the Michigan department rejected as an offset against its liabilities $157,566.22, "due for reinsurance," setting such amount (which is now paid) aside among items not admitted, as of no account in determining the condition of the company.—Ed.]

The market value of real estate and of bonds and stocks being variable, the difference between market and cost value is not a legitimate item of ledger entry, and is properly classed as contingent. If the cash market value is less than cost, the depreciation is deducted from the ledger assets after the balance is struck.

It is not claimed by the commissioner that all the assets which are denominated *contingent* are not legitimate and *bona fide*, or that the same are not valid set-offs against the liability of the company; but it is held that in the inventory at the close of each year the *realized* portion of the assets which come through the channel of *actual income* should, on the books of the company, be kept entirely distinct from assets *in expectancy*. The items of deferred and uncollected premiums—figuring largely in the statement of nearly every company—divested of the loading, are legitimate and valid assets against the reserves charged up as a liability upon the policies represented by such expectant income.

The same contingency of collection which is inherent in an uncollected premium does not attach with equal force to the items of accrued interest or interest due and unpaid; but the practice of making oath that such interest has actually been received and is a part of cash income is reprehensible morally, and cannot be defended as in harmony with a correct system of accounts. There are other contingencies, besides non-payment by the mortgageor of interest due, in the way of its actual receipt by the company, which readily suggest themselves. The principle of including in income only such items of cash and notes as have actually *crossed the counter of the company* may safely be adopted as true and correct; and any system which necessitates entries and cross-entries should be condemned and abandoned.

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* Furniture and commuted commissions should be charged out as disbursements, and not be accounted as a ledger assets. If called an asset by the company, it should be as contingent.

It is obvious that if to the realized or ledger assets at the end of any one year the actual income of the succeeding year is added, and from such total the disbursements during such year subtracted, the remainder will be the balance of net or ledger assets on hand at the close, provided the accounts are so kept as to render a plain business statement practicable.

The reasons for not admitting the items enumerated have in previous reports been fully set forth. It is not claimed that all are entirely worthless, but it is maintained that they form no valid set-off as against the reserve fund and claims for death losses. The items of such non-admitted assets have been printed in the detailed statements as they were given by the companies, and the rejected items again noted and combined, that those who examine them may review the judgment of the commissioner as to their value and availability.

In no instance has the commissioner revised the statement as to income and disbursements without first returning the same to the company, with a full explanation of the intent of the blank form and a request to amend. If erroneous deductions have been made at this office in the desire to place all upon the same basis and to arrive at the truth, the responsibility of the error must rest with the company in the imperfect manner of keeping accounts, or a complete misconception or perversion of the plain intent of the form of the statement.

That the imperfect manner of keeping accounts is wholly chargeable with these discrepancies, the commissioner desires to believe. Having, in a majority of cases, arrived at the net or ledger assets of the companies on the 31st day of December, 1872, there will hereafter be less difficulty in tracing the accumulations of succeeding years, of forming correct tables of ratios, and of ascertaining more nearly the actual per cent. of interest received on all the investments. Beyond this, the statement is designed to show the actual cost to the company of its real estate, bonds, etc., and the amounts claimed as market value over cost, separately, and the net amount of uncollected and deferred premium after deduction of the loading.

——THE annual report of the Royal Insurance Company, submitted at the meeting of the shareholders, held August 1st, at Liverpool, showed the total of the company's invested funds, January 1st, 1873, to be $12,016,426—a gain for the year of $561,771. Of the total assets, $8,014,880 represent the life accumulations; leaving over $4,000,000 as the guarantee of the fire business. Another great advance was made in the fire business in 1872, the premium reaching for the year $4,081,917, notwithstanding additional restrictions in the acceptance of risks. Losses of the year, $3,215,970, mark the severity of Boston and other fire calamities, yet the fire branch exhibits a surplus after providing for losses, expenses, &c. In the life department the new insurances were somewhat in excess of those of 1871; year's premium income $1,155,778; interest receipts, $301,695; losses and endowments paid, including bonus additions, $590,133.

In addition to the interim dividend of 3s. per share, paid in February last, the directors recommended a further payment, by way of bonus, of 5s. per share, making together 8s. per share, free of income tax.

With this hasty summary of this company's work and progress in 1872, we give a condensation of the conclusions of Commissioner Clarke, of Massachusetts, respecting the Royal, derived from his late official examination of the company at Liverpool, viz.:—

It is unnecessary to refer in detail to the working organization of the Royal, whose divisions, subdivisions, and executive officials are unremittingly holden to their appointed services. The strictest accountability is enforced in the management of its funds and other affairs, the *regime* extending even to shareholders; the latter, for any attempt to use the company's credit improperly or unlawfully, forfeiting stock and all other interests, monetary or otherwise, in the company.

The directors are empowered to transfer, at their discretion, in each year, the whole or any part of the profits or income to the surplus fund, and to increase and maintain such fund in such amount as they may deem proper. The fund thus reserved is now upwards of $1,300,000.

Another noticeable fact is the appointment of auditors by the directors and by the shareholders, each independent of the other, and uncontrolled by the company. With such a system of investigation, the affairs of any company are very certain to be carefully sifted.

Under a rule requiring weekly remittances from agents, and monthly and quarterly settlements with the home office, on penalty of summary discontinuance of business relations, the item of "agents' balances" is comparatively relieved from shrinkage or danger of absorption.

In a careful verification of its assets its practice was developed in the matter of market values. The company had only credited itself with the cost or ledger value of its United States securities, though entitled to represent their market value in its exhibit. The same was found to be true of some other securities, and also of its freehold estate. These values were upwards of half a million dollars in excess of the company's claim. Its investments and loans represented $1,273,000 in government securities; $5,625,000 in various railway securities; $2,357,000 in township and other securities; $271,475 in mortgages; and $957,425 in freehold property. The remaining assets were chiefly in cash. As in the worst financial crisis ever likely to occur, the company would hardly fail to realize a great advance, its substantial resources become still more apparent.

A large proportion of the company's fire risks are written for short terms, the great bulk ranging from a few days to a few months only. The reinsurance liability on its unexpired risks is always apparent on its books, the account being carefully made up in the monthly adjustments.

Referring to the statement of the Royal for 1872, which, with those of other foreign companies, has recently come to hand, we find a surplus of nearly $3,300,000 as regards policyholders.

The Royal preserves a complete classification of all matters pertaining to each department, great care being observed in securing to each its full and equitable share of monetary interest.

——KANSAS is a State in which life insurance displays a more vigorous manifestation than the fire branch. While the fire premiums are now at the rate of $300,000 per annum, the life premiums exceed $400,000. There is nothing exceptional in this, the American life premium is ahead of the fire premium, but, then, just as Kansas fire companies show a tendency to go away without requiring very big fires to make them, Kansas, in respect to life companies, tends to increase and multiply in number. "There are only three insurance companies organized under the laws of this State now doing business—one life and two fire companies," wrote the late Mr. Webb. Now, since this writing, and that not many months ago, Kansas life companies have increased 100 per cent., and the fire companies diminished 50 per cent.

Mr. Russell, the new superintendent of insurance, reports 29 fire, 18 life, and the Railway Passengers Assurance Company, as authorized to transact business in the State, July 31, 1873.

Fire companies authorized in 1872 wrote in Kansas $17,745,674, receiving $287,037.07 of premium, an average rate of 1.62. Losses paid, $99,256.20, of which $93,338.28 were on risks written during the year. Percentage of loss to premium, as respects exclusively risks in force during the year, 34.58.

The sole existing Kansas fire insurance company wrote in the State $1,902,304, at an average premium of 1.78 per cent. It also wrote risks to the amount of $777,795 outside of Kansas

The life statistics, which are incomplete, show $7,688,467 of life insurance in force in Kansas, December 31, 1872—2,923 policies; written during the year, 998 policies—$2,649,876 insurance; premium receipts, $338,395.88; losses paid, $57,530; losses incurred, $83,962.

The Missouri Valley, of Leavenworth, wrote in the State in 1872 269 policies, insuring $639,759. Total Kansas risks in force, December 31, 917 policies, $2,537,296 insurance; whole business, 2,993 policies, $7,562.360 insurance in force. Both this company and the new Alliance Mutual (official organization now complete) are much given to registered policies.

——THE Eclectic Life Insurance Company of New York has done its best. It goes into the hands of a receiver, appointed September 12th by the New York court of common pleas, on the application of Mr. Masters, director and stockholder. Why the delay in taking such an excellent step, is a conundrum like that of why some poor people who are nearly starving keep three or four dogs. The non-success of this feeble experiment should have had a much earlier termination. It appears, however, that no policies were issued after May last, when an attempt was made to patch up a reinsurance which would save some of the capital for the stockholders. Assets at the close represented at $180,017, and liabilities at $257,416, unadmitted assets, $40,000, making the company $109,031 worse off than it was January 1, by its showing to the N. York insurance department. That it was really in a sadder plight at the date of its collapse than at the close of '72, may be readily admitted, whatever may have been its position at the latter-named date; and the Eclectic was at least $81,392 worse off as the result of its business in 1872, when it made a net addition of 73 to the number of its policies in force. The New York department admitted the asset figures of its last statement to the amount of $337,982.46, of which the realized cash or investment assets were $173,934.99. Cash in company's office reputed at $14,085.59. Mr. Stephen Barker, a stockholder, makes affidavit that "the real cash in the office of the company was so made out when the statement was made up as to appear $10,000 or $12,000 larger than it really was." Had the Eclectic closed up January 1, 1872, it is probable that its $150,000 capital might have been rescued.

——PART II, Vol. II, of The Insurance Cyclopædia, is at hand. The work in its progress has now reached D, eleven titles with this initial closing the last serial issue, which breaks off in the course of an interesting biography of William Dale, one of the early explorers in the English field of life probabilities and annuity calculations, nearly cotemporaneous, yet prior to the introduction of the Northampton table, and especially notable for his investigations into the inequitable charges and false assumptions of the old age annuity associations of his time, which rested upon annual premiums in youth. Dale was an unpretentious person, and the rescue of his merits from oblivion has been on the part of Mr. Walford a labor of love and love of justice. He appears to have been a man of shrewd discernment, and endowed with a breadth of mental view from which the mere mechanical computer is wonderfully exempt. Consumption, the most important life insurance observation in respect to disease, receives from Mr. Walford very copious treatment, covering much ground of its general statistics and mortality tabulations, and the companies' experiences. All that pertains to consumption as a theme of social science being allied to its life insurance investigation, there is presented a large array of facts and considerations with respect to the relations of the subject to numerical population, personal and social conditions, climatology, &c., judiciously avoiding any pathological disquisition. In the legal notings of this number of the series the contract of insurance itself falls in its place. It is a general review, showing the law character of each class of policy. Prominence is given to the exploding of Lord Ellenborough's decision (*Goodsall* vs. *Boldero*, creditor policy on life of William Pitt) in 1807, (erroneously dated 1803, but Pitt did not die till 1806,) viz., that life insurance is a contract of indemnity—*i.e.*, solely compensatory for loss sustained, which error had sway for nearly half a century, namely, until overthrown by *Dalby* vs. *India and London Assurance Company* in 1855, in which it was held that cessation, of interest by a creditor-holder of a life policy does not invalidate such policy. Non-valuation of the insured subject likewise places accident and health insurance under the head of non-indemnity. Fidelity guarantee, as a personal contract, is one of indemnity. We notice that Mr. Walford applies the phrase—moral hazard—to both of these general divisions of insurance. The phrase will, however, be defined in its proper place. In the United States it applies exclusively to personal conduct abstracted from the hazard of the subject. Last, we cite as of peculiar interest—Copenhagen, a city with a suggestive history in respect to fires and fire insurance. All insurance in the capital of Denmark is a monopoly, excepting as illegally interfered with by foreign companies. A municipal organization takes all the buildings, the Royal Octroied Insurance Company all the goods and furniture. The financial figures of the latter are given for all the years from 1815 to 1852 inclusive; the average premium never reaching 1 per cent. of amount at risk; the loss always a much smaller percentage of amount at risk, apart from the result of an exceptional fire in 1844. Both percentages, however, got closer together in the later years, and the amount written increased with decreasing rates.

——COMMISSIONER CLARKE'S tabulations of the statistics of the fire and marine business of the Massachusetts companies for the year ending Dec. 31, 1872, give the annexed aggregates:—

	Risks written.	*Risks in force, Dec. 31.*	*Assets.*	*Liabilities.*	*Ratio of loss to am't at risk.*	*Ratio of loss to premium.*	*Ratio of exp. to premium.*
53 mutual fire ins. companies,	$157,698,650	$359,022,172	$4,611,286	$3,987,282	0.02@2.10	.35@530.10	3.40@73.38
7 mutual marine and fire-mar'e ins. comp'es,		19,942,413	3,129,581	2,337,490		55.5@1.397.2[*]	7.2@15.1[†]
12 joint-stock insur. comp's—fire and mar.,	98,034,410	119,796,494	3,748,596	3,996,280[‡]	.9@4.8	7.2@110.0	10.78@73.22

——BY the Kentucky commissioner's report, the life insurance business of the State, at the close of 1872, was: 22 companies doing business therein; policies in force, 11,499; insurance $41,172,301.74; policies issued during the year, 3,185; insurance, $9,544,124; premiums received in the year, $1,467,819; losses paid, $540,002.

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[*] Marine.

[†] Not including Pacific Mutual, now closing up.

[‡] Including capita stock.

——The National convention of State insurance officials began its annual session in Boston, September 17th, and the meetings were continued for four days. Eleven States were represented, viz.: Maine, New Hampshire, Massachusetts, Rhode Island, New York, Pennsylvania, Kentucky, Missouri, Wisconsin, Michigan, and Arkansas. Hon. Ll. Breese, president; Hon. Oliver Pillsbury, secretary. Standing committees, appointed by the chair, as follows:—

On Preparation of Blanks for Company Returns—Kelley, Row, and Harvey.
On Assets and Investments—Nye, Clarke, and Barnes.
On Rate of Mortality, etc.—Smith, Pillsbury, and Chapman.
Taxation, Deposits, and Fees—Barnes, Spear, and Row.
Dividends, Expenses, and Appointment of Attorneys—Harvey, Clarke, and Pillsbury.
Miscellaneous Questions—Clarke, Chapman, and Smith.
On Legislation—Chapman, Breese, and Clarke.

Messrs. Smith, Row, and Chapman, were appointed a special committee on amalgamation of life insurance companies.

A special committee reported that all the "loading" on uncollected and deferred life premiums should be deducted in making up the assets; that no policy should be reported lapsed on which any legal claim existed; that annual balance-sheets should be required from all companies; that separate registers should be kept of all Tontine policies, and a reserve required for all reported Tontine surplus; that any company reinsuring a risk simply at rate of age stated in the original policy should be required to maintain an extra reserve sufficient to make up the deficit.

Committee on taxation reported in favor of one per cent. State taxation of gross premium—approved. Mortality and interest rate left as they were. On the question of fire and marine reserves, the old standards adhered to. The most significant action of the body was the adoption of the following resolution:—

Resolved, That Messrs. Clarke, of Massachusetts, and Row, of Michigan, are hereby appointed a special committee to submit to the insurance companies of the United States copies of the present convention blank, and of the balance-sheet blank, proposed by Mr. Row, with a request that each company shall, before the 1st of May, 1874, communicate to the committee their opinion, in detail, as to the respective merits of each form of statement, suggesting such amendments as may appear necessary; and that said committee present such communication, with their own conclusions thereon, to the next convention, for final action.

Officers of the convention for the ensuing year: Orlow W. Chapman, New York, president; S. H. Row, Michigan, vice-president; Oliver Pillsbury, New Hampshire, secretary; executive committee—Julius L. Clarke, Massachusetts; J. W. Nye, Maine; J. M. Forster, Pennsylvania; Joel Spencer, Rhode Island; Lucien J. Barnes, Arkansas.

Next annual session will be held in St. Louis.

——Section 17 of the new Tennessee insurance law, an act to establish an insurance bureau, approved March 24, 1873, reads as follows:—

Be it further enacted, that if the insurance commissioner shall exact or receive, either directly or indirectly, any sum of money from any insurance company doing business in this State, other than the fees allowed by law; or shall wilfully issue a fraudulent or false certificate of soundness to any such company; or shall, directly or indirectly, receive any money or other valuable things for doing, or not doing, any official act as such commissioner, other than the fees allowed by law, he shall be deemed guilty of a felony, and, upon conviction, shall be imprisoned in the State penitentiary not less than one nor more than five years.

——Captain Eyre M. Shaw, the eminent chief officer of the London fire brigade, has written one of his admirable practical articles detailing the varied fire danger of theatres, and numerous precautions and safeguards to be attended to.——A rating committee of the National board has been in Saint Louis, revising the rates there, with a view of advancing ordinary risks 20 per cent., and specials 50 per cent.——Mr. Fielding L. Williams has been elected president of the Penn Fire Insurance Company, of Philadelphia, to fill the vacancy occasioned by the death of Mr. Charles H. Stokes.

——An obscure concern, passing under the name of insurance, and entitled The Hope Mutual Fire Insurance Company of Philadelphia, has been *supervised* by Commissioner Forster. The commissioner reports total admitted assets $24,201.87; total liabilities, including capital, $260,739.14. Included in the $24,201.87 of assets are $15,570.06 of gross premium yet to be collected. Cyphers are affixed by the commissioner as the values of a formidable array of "mortgages." The astonishing part of the disclosure is reinsurance reserve, $26,599.13, representing premium on oustanding risks of $53,198.26, while the commissioner carries inside as no offset to liabilities, "$94,766 of premium notes on the mutual policies in force." In a late advertisement of the Hope it represents itself pecuniarily as follows: Capital, $250,000; paid up capital, $225,000; total assets, $349,930.

——The proofs of a revival in the life business strengthen. Even the money panic through which we are passing suggests the reflection that, in the general uncertainty of things financial, a life policy is as good a resource, and in its way as safe, as a bank deposit. The judgment which is qualified to select a bank upon evidence, not faith, is qualified to select a life office in which to put trust. We note that, in the coming of the new spring, California also gleams with fresh verdure. The San Francisco Coast Review reports: "Life insurance is improving on this coast. Many of the agencies here have issued more policies already for 1873 than were issued by them during the whole of last year. Some of them will more than double their business of 1872 during the current year."

——The New York affairs of the North Missouri Insurance Company have not just now a very blissful aspect. Estimated unpaid fire and marine claims of the Eastern department about $50,000. The manager of the Eastern marine branch has levied upon agents' balances, brokers have been garnisheed, and a "high old time" in general is existing, which will probably not be a surprise to the uncompromising Church of the Ohio department. Messrs. Kissam & Anderson have succeeded to the agency for New York city, Brooklyn, Jersey City and vicinity; and this new firm announces that "a new and highly satisfactory statement of the financial condition of the company will shortly be issued."

Since the above was written we understand that the certificate of the North Missouri has been revoked by the New York department.

——Messrs. Charles E. Mather and George C. Crowell, Philadelphia, associate as the firm of Mather & Crowell, for the transaction of an insurance agency business Both gentlemen have had experience in fire underwriting, and of the best kind. Mr. Mather has had eight years' practice in the old American Fire—Mr. Crowell is of equal experience in the Pennsylvania Fire. He is a son of the esteemed secretary of the Pennsylvania. The antecedents and connections of the members of the new firm vouch for their fitness for the duties they have undertaken. Already the Philadelphia agency of three Providence companies has been assigned to this firm.

——The authorized agents of other-State and foreign fire and marine companies doing business in Massachusetts wrote, in 1872, $377,095,515 of insurance at an average premium of 1.13, against $331,733,239 in 1871, at an average premium of 1.21—somewhat indicative of the heavy falling off in rates before the great Boston fire of November, 1872.

——By the New York Insurance Patrol report there were, for years ended May 16, the following insurances and losses in New York city on the fire assailed buildings and contents:—

Year.	*Insurance.*	*Losses.*	*Percentage of losses.*
1872........	$11,072,755	$1,637,324	14.78
1873........	14,399,034	3,456,057	24.01

Average number of fires in New York city during the past 19 years, 769 per annum. Number in 1872, 1,017.

——We still elevate the flambeau. Each month now has a great flame story. We note since our last issue half a million gone in Belfast, Me., and a hundred and thirty families houseless. Another prairie fire in Chicago and Baltimore persisting in erasing, in flame, cinder, and ashes, the heretofore best fire record of any of the larger cities of the country.

——Our statement relative to Mr. D. H. Kline, in September Review, was slightly incorrect in one particular. Though connected with the Western department of the German, of Erie, Mr. Kline, we are informed, had not been nominal manager of that department. That position has been held since the organization of the department by Mr. Jacob Schlaudecker.

——The Alps Insurance Company of Erie, Pa., goes into bankruptcy, forced thereto by a Boston claimant. This company died on the hands of Commissioner Forster, as he, in the exercise of an official clemency, was according to its officers and stockholders an opportunity to effect a resuscitation of its affairs.

——The Spectator advocates an American Institute of Actuaries, and assigns to such body a good range of work. Certainly some national organization is needed to combine the results of American life insurance experience, and secure the extension and improvement of present basis data.

——The Orient Fire, of Hartford, the unsuccessful successor of the City Fire, assesses. Its capital stock was impaired 13 per cent. at the beginning of the year, and its stockholders are now called upon to make up an impairment of 25 per cent.

By later intelligence the company reduces its capital stock $150,000.

——Georgia is considered to be as good a State for surreptitious insurance as Pennsylvania. Legally accredited companies receive about $900,000 of fire premium per annum, the rest is smuggled over the border by Georgia brokers.

——Ordered by the State insurance commissioner to make up its impaired capital, the Central Fire, of Altoona, elects to withdraw from business, and will reinsure in the National Fire, of Philadelphia.

——There is something of an exodus among minor Pennsylvania fire insurance companies. The Williamsport Fire Insurance Company contemplates passing its risks over to the Lancaster.

——Judge Willard Phillips, author of the well known and standard Treatise on the Law of Insurance (written in 1823), died at Cambridge, Massachusetts, September 16th, aged 99 years.

——Suit has been brought to recover $30,000 on the life of Henry W. Bigelow, of Chicago—two policies of $15,000 each—one in the Berkshire Life, the other in the St. Louis Mutual Life.

——The St. Louis Mutual Life affair makes the city of St. Louis the hardest place in the United States just now for a solicitor to obtain a new life risk.

——The report that the Missouri Valley Life contemplates reinsuring is denied by the Western Insurance Review.

RAILWAYS AND TRANSPORTATION.

ACCORDING to promise, President Watson, at a meeting of the directors, held September 2d, presented a very full report of the condition and future prospects of the Erie railway, and the report is by far the most complete and satisfactory of any that has been lately put forth. The president, after alluding to the difficulties experienced in building the road, observed that the most serious mistake committed was the exceptionally wide gauge—6 feet—upon which the road was constructed, and alleged that this mistake had plunged the road into its present financial embarrassments by, first, greatly increasing its cost, and second, crippling its business capacity by greatly increasing the cost of repairs and preventing a free interchange of freight. He reiterates his opinion, heretofore expressed, that the Erie railway can be made fully equal to the other trunk lines; and that, in order to accomplish this result, about $40,000,000 will be necessary, which amount, he thinks, there will be no difficulty in raising after he shall have visited England and impressed his views upon the stockholders there. He again takes occasion to give his ideas very fully in regard to the only salvation left for Erie, and that is by getting, or rather retaining, for it is already secured, control of the Cleveland, Columbus, Cincinnati and Indianapolis railway, saying that this was the only line not controlled by either the New York Central or the Pennsylvania combination. This road, under the control of the Erie, will doubtless help the latter corporation somewhat; but how any considerable advantage can accrue from that source is a problem which will puzzle less sanguine minds. As the president confesses that the connection between Indianapolis and Terre Haute is owned jointly with the Pennsylvania company, as is also the case from thence to St. Louis, and with the States of Ohio and Indiana traversed as they are by other lines more directly connecting with the Pennsylvania system, and other shorter routes to the Atlantic, the means obtained by the recent negotiation of $10,000,000, convertible bonds, will be almost entirely expended during the year; and for the purpose of continuing the necessary work and purchases for meeting the constantly increasing business of the road, the president advises the issue of $10,000,000 more convertible bonds as soon as the stockholders can be induced to think as he does.

The accounts of the company, so far as ascertained, show that property to the amount of $8,312,380.02 has been fraudulently obtained by various persons heretofore connected with the management of the company, and this is believed to be only a portion of the actual amount. The president is in favor of a classification law which will prevent sudden and complete changes in the board of directors, and thinks the repeal of the former classification act, although brought about by the just dissatisfaction of the stockholders with the special board organized under its provisions, a misfortune not only to the public but to the stockholders of the Erie company.

A number of tabular statements are appended to the report, from which it appears that the liabilities are.................... $131,014,080.82

Balanced by cost of road	109,856,939
Bonds of other companies	3,941,781
Stock " "	5,396,410
Materials on hand	2,017,765
Real estate in New York	3,000,000
Balance of accounts receivable	1,559,510
Cash on hand	1,083,109
Unaccounted for	4,158,446.82

The following are furnished as the comparative earnings for the 9 months ending June 30, 1873 and 1872: 1873, $14,527,193.25; 1872, $13,441,619.74; increase, $1,085,573.51. The net earnings of the road for the same period (1873) were $4,433,849.02.

——THERE is but one opinion among those best qualified to judge of the effects of the attempts on the part of the farmers to regulate railroad charges for carrying freight and passengers, and that is that they are most mischievous. The last phase of this most extraordinary movement is a demand that railroads shall be taxed more nearly in proportion to the rate paid by private individuals. There is no gainsaying the abstract justice of the claim that railway corporations should, circumstances being equal, pay the same percentage of taxes as the surrounding community. But is not the assumption that they do not do so an erroneous one? Those who clamor for increased taxation seem to ignore the fact that the real representative of a railway is its stock and debt, usually held at a distance from the actual location of the road, and already bearing its proportion of taxes at the owner's residence. Such is not the case in relation to other property held under similar circumstances. A capitalist making a private investment at a distance can do so without being called upon to pay taxes other than are assessed upon his investment. We presume no one will assert the justice or expediency of putting upon railway corporations, as such, any greater proportion of the expenses of government than is borne by surrounding property; yet this is precisely what is now being attempted under the specious name of equality. If railroads are of no benefit to the communities through which they are constructed, why use them? If, as seems to be the case, they are not only useful, but absolutely indispensable, ought not those who build and operate them to be encouraged instead of disheartened? Is it encouragement to investors in this species of property, after the road has been built and the money spent beyond recovery, to say you shall carry at my price, and pay your expenses and get your dividends as best you may? We do not recall a single road, at least in any section of country where the complaints of oppressive monopolies are most rife, which pays its stockholders in dividends on an average more than the legal rate of interest. The compensation is usually much less; and surely, when the uncertain nature of the investment, and the usual length of time before which, even under the most favorable circumstances, any compensation whatever can be expected, is taken into consideration, a very high rate of interest ought not to be considered oppressive. If those who have invested in railways were free to withdraw their capital at any time without loss, the injustice of the proposed action would not be so apparent. It is a pity that only the capital but the superstructure could not be withdrawn for a limited time. Such an action would do more to open the eyes of people to the value of such things to the community than all the arguments that ever were or can be penned. Such an action is of course impossible, but the end is not less sure. Either a reasonable compensation will have to be paid, directly or indirectly, for the capital employed in operating railways, or capital will cease to be invested in such ventures, but will seek a more remunerative field.

——FROM the lately published report of the president of the partially finished Lewisburg, Centre, and Spruce Creek railroad, we summarize as follows: The road is projected from the Philadelphia and Erie, near Lewisburg, to the Pennsylvania Central, at Tyrone, and will be, when completed, about 87 miles in length. Eleven miles, from the Philadelphia and Erie junction to the western boundary of Mifflinburg, are already in operation, and 60 of the remaining 76 miles are under contract. The cost of the 11 miles in operation has been $262,102.39, and the estimated cost of the whole is $2,206,602, or in round numbers $25,400 per mile—not a very large estimate, considering the character of the country through which it is projected to be built. There were $2,000,000 1st mortgage 7 per cent. bonds authorized, of which amount the Pennsylvania Railroad Company has taken $1,500,000, and the Philadelphia and Erie company $45,000, leaving $455,000 undisposed of. The subscriptions to the capital stock amount to $346,700. The earnings of the 11 completed miles for the past year were $25,363.67—$2,305 per mile—and expenses were $21,227.88; leaving net earnings $4,035.79. From this exhibit, and the known valuable deposits of minerals and tracts of timber on the proposed line, the most favorable results are anticipated when the road shall have been completed.

——MR. SAMUEL TATE, who is regarded as principally responsible for the recent leasing of the Memphis and Charleston railroad to the Southern Security Company, and has been severely criticised therefor by some of the stockholders, comes out with a long letter to the Memphis Appeal and defends his course. He says, in substance: "I advocated the lease for two reasons: 1st. Because it promised a great through line from Bristol to Shreveport, and would probably relieve us who had made large advances to the Memphis and Little Rock road. 2d. As the Security company controlled its connections on the east, and was likely to do so on the west, the proposed lease promised higher dividends and better results than any other course. As I backed my opinion by purchasing, in connection with others, $400,000 of the stock at 40 cents, I cannot be accused of sinister motives. The cause of the stock receding so rapidly in price is that it had been kept up from an impression that the company had sufficient assets to pay the floating debt. This was an error; but it is now fully ascertained that in the next four years the 3 per cent. dividends will relieve the entire debt, and leave the company with the stock guaranted to pay 6 per cent., and this will make it worth from 60 to 70 at the least. My advice to the stockholders is to stand by the lease until the lessee clearly violates its contract, and then will be quite soon enough to criticize." In regard to the Memphis and Little Rock company, of which he is president, Mr. Tate, after stating that but for the energy and pluck of the present general manager, Mr. Greenlaw, there would have been no Memphis and Little Rock road, said that no second mortgage bonds—in regard to which he had been censured—were issued until it became necessary to raise the bed of the road above the Mississippi bottom, and then Mr. Greenlaw came forward when no one else would and advanced $700,000, without which the road was worthless.

After an unsuccessful attempt to lease the Memphis and Little Rock road to the Southern Security Company, Messrs. Tate and Greenlaw, finding that they could hardly hope to make the investment profitable to themselves for want of sufficient available capital, offered Col. Scott the control of the Memphis and Little Rock road for $160,000, which offer was declined by his board, and also by the Louisville and Nashville road, to which it was subsequenty made. The control of the Memphis and Little Rock road has always been offered to anyone who would take it on terms not absolutely ruinous, and the explanation of Mr. Tate as to his selling his interest in the lease of the Memphis and Charleston road is simply that he was obliged to do so.

——THE Peninsular Railroad Company, of Michigan, was consolidated with the Port Huron and Lake Michigan Railroad Company at the late annual meeting of the former company, and the combination is now known as the Chicago and Port Huron Railroad Company. The late Peninsular road is completed from Lansing to Valparaiso, Indiana—165½ miles—and its financial condition is as follows: Capital stock, $1,995,500; funded debt, consisting of 7 per cent. 1st mortgage bonds, payable in 1899, $1,800,000; and 2d mortgage 7 per cent. bonds, payable in 1900, $979,000—$2,779,000; floating debt, $142,263; making total liabilities, $4,916,263—about $29,000 per mile. The earnings of this road have been very light, owing to its dependence on local freights. The late Port Huron road has completed the line from Port Huron to Flint, Michigan—66 miles. This company was organized with a capital stock of $1,200,000, and an issue of $1,800,000 of 7 per cent. gold 1st mortgage convertible bonds has been authorized, or at the rate of $20,000 per mile of the proposed 90 miles of road. At the close of the fiscal year (October 31) $946,000 of these bonds had been issued. The capital stock paid in was $93,854.91, and the floating debt $70,498.50, making total liabilities $1,110,353.41—not quite $17,000 per mile—a very economical showing; the more as it also includes sidings and rolling stock. This road seems to have been operated quite as economically as it was constructed, as the earnings show a handsome surplus over operating expenses, interest, and discounts. The combined liabilities thus amount to $6,026,616.41. The unfinished link, 50 miles in length, between Flint and Lansing, will soon be completed, and this, with the arrangement to run trains into Chicago from Valparaiso, over the track of the Pittsburgh, Fort Wayne, and Chicago road, will make it a trunk line. The officers of the new corporation are: President, W. B. Lang, N. Y.; vice-president and general manager, W. L. Bancroft, Port Huron; secretary, E. B. Taylor, Port Huron; counsel, L. D. Dibble, Battle Creek; superintendent, E. B. Taylor; and chief engineer, Charles Palmer.

——Not content with the proposed Fort St. Philip canal, southern business men are just now agitating a scheme for inland transportation by water from the Rio Grande to St. Mary's, Florida. The first section of the proposed route—about 520 miles in length—is to connect the Rio Grande with Berwick's bay. Over 400 miles of this distance is said to be composed of tide marshes and lagoons, which would need but little dredging; the remaining 100 miles or so is seashore marshes, through which a canal could be cut without difficulty. From Berwick's bay the proposed canal is to be constructed through New Orleans to Lake Ponchartrain—a distance of 90 miles—utilizing 40 miles of canal already constructed; thence through the Rigolets, and so around the coast to the mouth of the Suwanne; and thence up that river to within 35 miles of the St. Mary's river, to which a connection will be formed by a short and comparatively inexpensive canal; thence down the St. Mary's to the ocean. The distance saved between the Mississippi and the Atlantic ports or Europe is estimated at fully 700 miles, and the work will cost nearly or quite $20,000,000. There seems but little sense in the scheme, even allowing the estimate that doubling the Florida cape adds $5,000,000 a year to the cost of transportation in increased insurance premiums. The idea of going out of the most direct possible route—an open seaway—and painfully digging a canal around a half moon shore, looks like a waste of money. If the dangers of the passage around Florida have not been exaggerated, it may be a judicious investment to canal the peninsula from the mouth of the Suwanne to that of the St. Mary's, utilizing both of these rivers as proposed in the plan; but here a question of finance again steps in. If the proposed Fort St. Philip canal—6 miles in length—is to cost $7,000,000, how can one 40 or 50 miles in length, and apparently through quite as difficult a country, be constructed for $10,000,000, or even twice that sum?

——We are in receipt of a tastefully bound copy of the American Railroad Manual, and unhesitatingly pronounce it by far the most complete work of the kind that has ever fallen under our observation. The material and workmanship of the volume are of the best quality, and the arrangement of the articles and perspicuity of the style render it of great value as a convenient book of reference. A brief history is given of each railroad completed, or now building, in the United States and the Dominion, its length, cost, present financial standing, connections, travelling accommodations, and a list and address of the directors. In the arrangement of the work the author has treated the railroads by States in the order in which they are most frequently named, commencing with Maine and ending with Oregon; and this arrangement, which is preceded by a very complete alphabetical index of the different corporations by name, leaves nothing to be desired in this regard—the more especially as the railroads of each State are also arranged alphabetically. Another commendable feature of the work is the preceding of each State or group of States by a finely executed railroad map, and these with a general railroad map of North America, greatly enhance its value as a manual. A directory of railroad officials divided into executive, transportation, and mechanical; and these again judiciously subdivided, supplement the work, and enables one without trouble to find the name and address of any railroad official, and is not the least of the attractions of a book which must be invaluable not only to railway managers, but to brokers and capitalists. Although the style is very concise, the work covers about 600 pages. It is appropriately dedicated to J. Edgar Thomson, president of the Pennsylvania Railroad Company. Published by J. B. Lippincott & Co.

——The late decision of the United States Supreme court in the case of the Philadelphia and Reading Railroad Company *vs.* The Commonwealth of Pennsylvania, while following in the line of former decisions, goes a step further, and defines with great clearness the meaning of that clause in the national constitution "giving congress power to regulate commerce between the several States." The case arose under a statute of the State of Pennsylvania, passed in 1864, taxing the freight carried by any and every carrying company in the State. The Supreme court of Pennsylvania affirmed the constitutionality of the statute, and the case went to the Supreme court of the United States upon a writ of error, where the act was declared in conflict with the constitution of the United States, and therefore void. The syllabus of the case defines the rule to be that "any State has the power to tax its own internal commerce at discretion, but that in so doing it must not interfere with inter-State trade or commerce." In so far as the act in question imposes a tax on freight carried through the State, or upon freight brought from without into the State, or upon freight taken up within the State and carried beyond the borders thereof, it is unconstitutional and void.

PATENTS, ARTS, AND SCIENCE.

[This Department is under the editorial charge of WILLIAM H. WAHL, Ph. D.]

THERE were some signs of reaction in the iron market late in August and early in September, from the previous depression, No. 1 pig showing a decided advance; lower grades firm at former prices, with an improvement in gray forge; and considerable sales in the inferior grades. Some of the No. 2, however, above the average standard, was offered and accepted at $38. There was some activity in Scotch pig in New York, at prices $2 below quotations. With more demand at Liverpool and Clyde, prices have advanced. Total shipments for August, 50,073 tons, against 82,242 tons same month last year. The trade at this writing is greatly impeded by the panic—through lack of confidence. Negotiations for rails by the companies are at a stand-still.

August-September Iron Report.

	30th.	6th.	13th.	20th.
AMERICAN FOUNDRY PIG:—				
No. 1	$43.00	$43.00	$43.00	$42.00
No. 2	38.00	38.00	38.00	37.00
“ (plain)	35.00	35.00	35.00	34.00
No. 3 (gray forge)	33.00	33.00	33.00	32.00
No. 4 (mottled)	30.00	30.00	30.00	29.00
White	28.00	28.00	28.00	27.00
SCOTCH PIG:—				
Gartsherrie	46.75	49.30	51.52	49.88
Coltness	48.83	49.30	51.52	51.93
Summerlee	46.05	47.21	49.20	48.51
Langloan	47.03	48.60	50.13	49.20
Calder	46.75	48.60	50.13	48.51
Carnbroe	45.50	47.21	48.75	48.51
Glengarnock	45.77	47.21	48.75	48.51
Eglinton	44.67	45.96	47.37	47.14
Dalmellington	44.67	45.96	47.37	47.14
Old rails, D.H.'s	48.00	47.00	46.00	46.00
“ T's	47.00	46.00	45.00	45.00
No. 1 Wrought scrap	40.00	41.00	43.00	43.00
Cast scrap (machinery)	31.00	33.00	33.00	34.00
Stove-plate scrap	30.00	30.00	30.00	30.00
Wrought turnings	35.00	34.00	33.00	33.00
Cast “	25.00	24.00	24.00	24.00
American refined bar	$3\frac{5}{10}$c.	$3\frac{5}{10}$c.	$3\frac{5}{10}$c.	$3\cdot\frac{5}{10}$c
“ common bar	77.00	77.00	77.00	77.00
“ rails	77.00	77.00	77.00	77.00
English rails (ex. ship.)	75.00	75.00	75.00	75.00
Railroad spikes	.04	.04	.04	.04
Nails (⅌ keg)	4.25	4.75	4.75	4.75
Street rails (deliv'd on car, Broad & Willow)	77.00	77.00	78.00	80.00

——WE have received from Herr Krupp's American agents (Thos. Prosser & Son, New York,) a circular containing a detailed account of the great cast steel works of Friederich Krupp, from which we abstract the following:—

The cast steel manufactory, near Essen, was established in the year 1810. It was conducted by Mr. Alfred Krupp from the year 1826, and in 1848 he became sole proprietor. The works have been steadily extended from the time of their foundation until, in January, 1873, they covered a continuous area of about 1,000 acres, of which not less than 200 are under roof. There are more than 12,000 workmen employed, independent of about 2,000 who are engaged by building contractors. In the mines and smelting works belonging to the establishment there is employed an additional number of workmen, about 3,000; thus running up the grand total to 17,000 men, besides 739 officers and office employés. The quantity of cast steel produced in the year 1872 exceeded 125,000 tons, consisting of axles, wheels, tires, and crossings for railways, rails and springs for railways and mines, shafts for steamers, different pieces of machinery, boiler plates, rolls, spring steel, tool steel, guns, gun carriages, shot, &c. There are now in operation 250 smelting furnaces, 390 annealing furnaces, 161 heating furnaces, 115 welding and puddling furnaces, 14 cupola and reverberatory furnaces, 160 furnaces of other kinds, 275 coke ovens, 264 smith's forges, 240 steam boilers (besides 70 more now in course of construction), 71 steam hammers, viz.:—

Numbers........	2	1	2	1	5	3	1	7	8	18	2	1	6	2	3	4	1	1	1	1	1
Cwt. (each).....	2	3	4	7	8	10	12	15	20	30	60	65	70	75	100	110	140	150	200	400	1000

Two hundred and eighty-six steam engines, viz.:—

Numbers........	3	57	46	16	17	6	1	4	38	4	21	16	3	22
H.P. (each).....	2	4	6	8	10	12	13	14	16	18	20	23	25	30
Numbers........	5	2	4	4	2	3	1	5	1	1	3	1		
H.P. (each).....	35	40	45	60	80	100	120	150	200	500	800	1000		

Representing, altogether, nearly 10,000 horse-power. In addition, there are 1,056 machine tools, viz.: 362 turning lathes, 82 shaping machines, 195 boring machines, 107 planing machines, 42 punching and grooving machines, 32 pressing machines, 63 grinding machines, 31 glazing and polishing machines, and 142 machines of different kinds.

In 1872 there were consumed in the works: Coal, 500,000 tons; coke, 125,000 tons; water, 113,000,000 cubic feet, supplied from several water works; gas, 155,000,000 cubic feet, supplied by the gas works of the establishment, for 16,500 burners.

The works are in connection, by rail, with the Cologne-Minden, Bergisch-Märkisch, and Rhenish lines of railroad; while, to facilitate traffic at the works, there are about 24 miles of track of usual gauge, with 180 sidings and 39 turn-tables, on which run 12 tank locomotives (diameter of cylinder, 16 inches), and 530 cars; and 6 more locomotives are now in course of construction. Also, about 10 miles of narrow-gauge track (30 inches), with 147 sidings and 65 turn-tables, on which run 3 locomotives (diameter of cylinder, 6 inches), and 270 cars; and 4 other locomotives are now building. Horses are also used on the narrow-gauge road. The carting department comprises 191 horses and 272 carts. To facilitate communication between the several workshops there are 30 telegraph stations. The works are guarded by 166 watchmen, and a permanent fire brigade of 70 men, who also perform police duty.

There are general supply stores, which furnish to volunteer purchasers (belonging to the works) for cash, provisions, clothing, dry goods, boots, &c., at cost prices. The receipts at present amount to about $55,000 gold, monthly, and are constantly on the increase. In this department there are one hotel, three beer houses, one selters-water manufactory, one flour mill, and one bakery, with two steam engines, producing on an average 85 tons of bread monthly. For the officers there are 266 dwellings, and for the workmen 2,948, either inhabited or in course of construction. At the present time there are living in these houses more than 8,000 persons. Additional dwellings are in progress. The existing boarding-houses offer board and lodging to 2,500 unmarried workmen, and other houses are now in progress, with accommodations for 1,600 more. The arrangements for the accommodation of the sick consist of one hospital containing 100 beds, and one epidemic hospital with 120 beds, all under the supervision of physicians especially employed for this service. A sick, burial, and pension fund has also been instituted for all workmen who receive wages from the proprietor; the latter contributes to this fund half the amount of the contributions paid in by the members—also provides pensions and support for those who have been rendered unfit for work in his service, and for the widows of the workmen. The total receipts for the year 1872 amounted to $80,000 gold, the expenditures to $62,500 gold, and the fund on hand at the beginning of the present year (1873) was $96,740 gold. From another fund members receive for their familes medical treatment, on payment of 75 cents annually; otherwise, free.

The proprietor has also established a chemical laboratory, a photographic and lithographic atelier, and a printing and book-binding establishment. In the printing office there are two steam and four hand presses in operation.

Besides the cast steel works, near Essen, Fried. Krupp possesses a number of mining and smelting works, which secure exemption from fluctuations in prices, and assure a regular and uniform supply of the best raw material. This department includes four coal pits, with important concessions in the mines on the left bank of the Rhine; iron-ore mines to the number of 414, with an an area of 50,000 acres, to which must be added certain important concessions of excellent iron-ore beds in the north of Spain, from whence it is intended to import annually as much as 300,000 tons for the production of cast steel. To facilitate this work a railway in Spain, nearly eight miles long, as well as several steamers, are now building. The smelting works are five in number, with eleven blast furnaces, and their monthly production is nearly 10,000 tons.

——THE art of reproducing photographic images rapidly and cheaply by a mechanical printing process is being steadily developed, and we may expect at no distant day to see it brought to such a state of practical perfection as to take the place in a great measure of the lithographic process now in almost universal use. It was discovered some years ago that a film of gelatine saturated with bichromate of potassa, acquired, on exposure to light, certain properties, which have since that time to the present taxed the ingenuity of numerous observers to utilize. The most important of these properties is, that in those parts where the light has acted upon such a film it will take up greasy ink precisely like a lithographic stone, while the parts unaffected by the light will absorb water. A number of photo-lithographic processes depending upon this property for their efficiency have been announced from time to time; but few, if any, appear to possess all the qualifications requisite for extended adoption in practice.

The Albertype process, discovered by Albert, of Munich, is one of the latest and best. In this process a plate of moderate thickness is coated with a thick film liquid of bichromated gelatine, which is subsequently exposed to the light to render it insoluble. This is then covered with a thin coating of sensitive gelatine, which is thereupon exposed to the light beneath the negative it is desired to reproduce; from the film thus obtained, which is rendered insensible to further change by washing, most excellent prints are obtained by the lithographic process.

The Heliotype process—the latest development of the art—differs from the one just described in a number of details, by which it is claimed greater toughness, durability, and freedom in manipulating the films are secured. Mr. E. Edwards, the discoverer of the process, adds alum to his bichromated gelatine solution, and finds that by this addition, while the sensitiveness and subsequent ink-absorbing quality of the films are not in the least impaired, they possess to a far greater degree than has yet been obtained the property of swelling very slightly in water, and the power of resisting the action of the printing press. The gelatine films are spread on finely-ground glass plates, which are so prepared by polishing with wax as to admit of their subsequent removal. The films, carefully dried, are exposed beneath the negative. The impressed films are then washed in the dark-room and caught on zinc plates. To these the films are firmly attached by pressure, by which, at the same time, all remaining traces of free bichromate are removed. The films thus prepared are then ready to undergo the printing process. By varying the consistency of the ink it is possible to print in several colors; the stiff ink affecting only the portions most changed by the light, while the thin will take hold of the half tones. After use the films are removed from the zinc plates and preserved for future printing.

——The influence of the metallic pipes, in which water is conveyed to our dwellings, upon its healthfulness, is a matter of importance sufficient to command attention. There exists a very wide-spread belief that water is very decidedly affected in its passage through lead pipes—so much so in many, if not all cases, as to render the water injurious to the health. It has, however, been abundantly proved, by faithful scientific investigation, that this view is erroneous, for there exist no authenticated accounts of the health of the innumerable cities and towns supplied by lead distributory pipes having been injuriously affected through this cause. The cause of this impunity, according to the most reasonable theory advanced, resides in the extraordinary influence exerted by the small quantity of carbonic acid which the softest natural waters invariably contain. The effect of the presence of this gas is to convert any oxide of lead which may be dissolved into carbonate, which is practically insoluble ($\frac{1}{80}$ of a grain dissolves in a gallon of water). In elaborate experiments made with a view of testing this point it was found that pure water, in contact with lead for twenty-four hours, became highly poisonous; while, under the same circumstances, water containing 3 per cent. of carbonic acid remained perfectly safe. There are, it is true, certain causes which may to a limited extent (as in the supply of one or several dwellings) give rise to distressing accidents, such as the possible presence in the pipes of decaying organic matter or other impurities. Such cases are, however, from their character necessarily local, and cannot, except by the rarest combination of circumstances, disturb the healthfulness of the water supply of a city or town.

The substitution of tin-lined lead pipe, block tin, or galvanized iron, has each been suggested in the place of lead, and each plan has found warm advocates, and doubtless possesses its own advantages. It would seem, however, on examination of the subject, that while the introduction of either of these substitutes is attended with serious practical objections, an appreciable superiority, in a sanitary point of view, is gravely to be doubted. Block-tin pipe, though very harmless, is by no means as durable as lead, being rapidly decomposed by limestone waters, and is, besides, too costly for this purpose, as the supply of this metal even in its present industrial applications can scarcely keep pace with the demand. Tin-encased lead and galvanized iron pipes are likewise open to objections, which seem to more than counterbalance the advantages claimed for them. It is impossible in practice to *perfectly* protect the surface of one metal with another. Under the most favorable circumstances flaws will exist, and, where these occur, we have all the conditions necessary for a galvanic circuit, (two metals in contact with each other, and an exciting liquid,) an electro-chemical action sets in, whereby the more electro-positive metal is more rapidly decomposed by the water than if present alone.

It seems, therefore, established that, taking all essential conditions into consideration, namely, health, durability, and cheapness, lead for water pipes is to be preferred to any substitute that has as yet been proposed.

In conclusion, it is interesting to record that the report of an English commission of scientific gentlemen, appointed some years since to investigate this question in its sanitary relations, declares in favor of lead for water conduits; and—as a curious offset to the suspicion so generally entertained concerning the healthfulness of water supply through lead pipes—the report contains the statement that the purest water analyzed, during an extended examination, as to the most available source from which to supply the city of London, came from a lake which received all the washings from neighboring lead mines.

——The International Patent Congress, which recently held its sessions in Vienna, after considerable discussion, adopted the following resolutions:—

1. The protection of inventors should be guaranteed by the laws of all civilized nations, because: *a.* The sense of right amongst civilized nations demands the legal protection of intellectual work. *b.* This protection affords, under the condition of a complete specification and publication of the invention, the only practical and effective means of introducing new technical methods without loss of time, and in a reliable manner, to the general knowledge of the public. *c.* The protection of invention renders the labor of the inventor remunerative, and thereby induces competent men to devote time and means to the introduction and practical application of new and useful technical methods and improvements, and attracts capital from abroad, which, in the absence

of patent protection, will find means of secure investment elsewhere. *d.* By the obligatory, complete publication of the patented invention, the great sacrifice of time and of money, which the technical application would otherwise impose upon the industry of all countries, will be considerably lessened. *e.* By the protection of inventions, secrecy of manufacture, which is one of the greatest enemies of industrial progress, will lose its chief support. *f.* Great injury will be inflicted upon countries which have no rational patent laws by the native inventive talent emigrating to more congenial countries where its labor is legally protected. *g.* Experience shows that the holder of a patent will make the most effectual exertions for a speedy introduction of his invention.

2. An effective and useful patent law should be based upon the following principles: *a.* Only the inventor himself, or his legal representative, should be entitled to a patent. *b.* A patent should not be refused to a foreigner. *c.* It is advisable, in carrying out these principles, to introduce a system of preliminary examination. *d.* A patent should be granted either for a term of fifteen years, or should be permitted to be extended to such a term. *e.* Simultaneously with the issue of a patent, a complete publication of the same should take place, rendering the technical application of the invention possible. *f.* The expense of obtaining a patent should be moderate; but, in the interest of the inventor, a progressive scale of fees should be established, enabling him to abandon, when convenient, a useless patent. *g.* Facilities should be given, by a well-organized patent-office, to obtain in an easy manner the specification of a patent, as well as to ascertain what patents are still in force. *h.* It is advisable to establish legal rules, according to which the patentee should be induced, in cases in which the public interest may require it, to allow the use of his invention to all responsible applicants for an adequate compensation. *i.* The non-application of an invention in one country shall not involve the forfeiture of the patent, if the patented invention has been carried into practice at all, and if it has been rendered possible for the inhabitants of such country to purchase and make use of the invention. *k.* In all other respects, and particularly as regards the proceedings in the granting of patents, the congress refers to the English, American, and Belgian patent laws, and to the draft of a patent law prepared for Germany by the Society of German Engineers.

3. Considering the great differences in present patent administration, and the altered international commercial relations, the necessity of reform is evident, and it is of pressing moment that governments should endeavor to bring about an international understanding upon patent protection as soon as possible.

4. The congress empowers the preparatory committee to continue the work commenced by this first International congress, and to use all its influence that the principles adopted be made known as widely as possible, and carried into practice.

5. The committee is likewise authorized to endeavor to bring about an exchange of opinions on the subject, and to call from time to time meetings and conferences of the friends of patent protection.

6. To this end the preparatory committee is hereby appointed to act as a permanent executive committee, with power to add other members to its number, and to appoint the time and place for the next meeting of the congress, in case such a meeting should be considered necessary for the promotion of the foregoing resolutions.

——PITTSBURGH claims to have in process of construction a pair of engines which will be the most powerful in the world. Reducing the capacity of some of the largest pumping engines to a uniform lift of one foot in 24 hours, it is estimated that the one at the Lehigh zinc mines (at Friedensville, Pa.), will lift 3,450,000,000 gallons; the pair at the Chicago water-works, 4,500,000,000; the pair at Haarlem, Holland, 10,000,000,000; while the new Pittsburgh engines, it is claimed, will lift 14,240,000,000. The pair will weigh 1,500 tons, and cost $423,550. The following details furnish some of the weights and dimensions: Cranks, 9 tons; shaft, 24 tons; four sections of the two valve chambers, 120 tons; fly-wheel, 70 tons. The four plungers will weigh upwards of 400 tons. Cylinder, 64 inch diameter, stroke 14 feet; plungers, 60 inch diameter, 11 feet stroke. These ponderous pieces of mechanical work will be used to raise water into Highland Avenue reservoir, in Pittsburgh, a height of 356 feet. It is estimated that they will raise 70,000,000 pounds of water for each 100 pounds of coal consumed, the cost being at the rate of one cent for every 3,070 gallons.

——We give this month a note of one of the manufactures of Charles Williams, of Philadelphia, whose establishment is devoted to the business of heating and ventilating buildings. The topic we select is the construction and operation of the successful and popular heater known as the "Golden Eagle Furnace," of which Mr. Williams is the exclusive maker. The apparatus has a number of advantages, of which the more prominent are, that it is a producer of pure air, that it is economical, and at the same time simple in construction, durable, and inexpensive. This furnace is furnished with a hygrometric arrangement, by which the warm air delivered contains an ample supply of moisture for health and comfort—a condition which, in many forms of construction, is looked upon as of secondary importance. In point of economy the heater possesses the peculiarity of a small fire-box and an unusually large heating surface—the entire amount being directly above the fire. It is claimed, indeed, by the manufacturer that it possesses double the amount of heating surface of any other at present constructed. There are attached as accessories a patent dust-box and regulator, by which the fire door may be kept closed the entire winter, thus affording the advantages of a saving of fuel, a steady fire, and a tolerably equable temperature, and avoiding in a great measure, consequently, the great wear upon the furnace, which commonly results from excessive and unequal expansion. All the interior parts are accessible for examination and repairs from the front. It is very solidly built, and especially in those parts liable to much wear or strain; while the construction, workmanship, and materials are claimed to be of the highest character. The adaptation of the patent draft-box and regulator, before referred to, obviates the necessity of opening and closing the feeder door for the purpose of increasing or decreasing the draft. The hygrodeik of Mr. W. Edson, the manufacturer designs to employ in connection with his furnaces, by which the condition of the air of a room may be at once indicated, giving as it does, at a glance, the dew-point and relative humidity without necessitating a calculation.

We have chosen this one of the many manufactures of Mr. Williams for description, as it probably affords most material to interest readers in a detailed account. The establishment has been successfully conducted by Mr. Williams for more than thirty-eight years, and possesses facilities of very complete character in every department of heating and ventilating, manufacturing furnaces, registers, and ventilators, cooking ranges, bath boilers, water backs, low-down grates, heaters, &c.

——The following official information, upon a subject of much interest to engineers and the public in general, has recently been made public: The commission appointed by the United States government to inquire into the causes of steam boiler explosions, in order to determine by actual experiment the best form and construction of safety valves which shall operate automatically in relieving the steam boiler from the pressure of the steam, or with certainty to automatically prevent any increase of pressure above that at which the valve shall be set, invite persons claiming to have valves of superior efficiency to submit one to the commission for examination and testing. All valves presented must have an area of exactly five square inches in their discharge openings, and the flange for attaching to the boiler must be eight inches in diameter, flat face, without bolt-holes; valves to be sent, charges prepaid, and communications on the subject addressed to Addison Law, supervising inspector, No. 23 Pine street, New York city, before October 10, 1873.

The commission, at a recent meeting held at Washington, decided to call for coöperation and advice in the performance of their allotted duties upon engineers, inventors, and scientific societies. The points upon which the commission solicit information are the following: 1. Explosions caused by the gradual increase of steam pressure. 2. Those caused by low water in overheating of the plates of the boiler. 3. Those caused by deposit of sediments on the inner surface exposed to the fire. 4. Those caused by the generation of explosive gases within the boiler. 5. Those caused by electrical action. 6. Those caused by the percussive action of the water in case of rupture of the boiler in the steam chamber (the Clark and Colburn theory). 7. Those caused by the water being deprived of air. 8. Those caused by the spheroidal condition of the water. 9. Those caused by the repulsion of the water from the fire-surfaces or plates. Communications intended for the commission upon these or relative matters should be addressed to Mr. Taylor, the secretary of the experimental commission, at the treasury department, Washington, D. C.

——A PROPOSITION of some mechanical interest, namely, the application of the compound principle to locomotive and other engines, was recently presented before the Manchester Scientific and Mechanical Society by William Rayner. Upon the plan proposed by the author named, the steam was to be used at from 240 to 250 pounds to the square inch in the small cylinder, which was subsequently to be expanded into a supplementary boiler bearing a pressure of 60 to 65 pounds to the square inch, so as to have a surplus or effective pressure of 180 pounds or 190 pounds in the small cylinder, or about 60 or 65 pounds in the larger ones. The principal alterations will be in the boiler. In adapting this plan to locomotives of medium size, the boiler, or rather the boilers, will be two feet longer than at present, and will be divided into two distinct parts; the part containing the furnace or fire-box to be two feet shorter than at present, so as to have the supplementary boiler four feet larger, both being of equal diameter, and with equal number, size, and position of tubes, the two parts of the boiler being firmly bolted together, and the boilers so arranged that the tubes of the one are in a line with the other, so that the hot air and flame may pass freely through from one to the other. A very important advantage claimed by this plan is, that the driver of the locomotive will be enabled to start his engine with the full power of steam in both cylinders at once, which he could not do if compounded in the usual way. Although this plan will require extra outlay, there will be a considerable saving in fuel, which, with other advantages, will, it is claimed, more than compensate for the extra cost.

——THE English technical journals report some interesting observations concerning the conditions under which safety lamps are really safe—the same having been made under the supervision of Mr. R. Galloway. The author in question had already published the observation that if a Davy lamp be burning tranquilly in an explosive atmosphere, the transmission of a sound-wave, produced by a slight explosion of gunpowder, is sufficient to determine the communication of flame from the lamp to the surrounding atmosphere. Hitherto it has generally been assumed that the occurrence of a colliery explosion, after firing a shot, is due to actual communication of flame from the gunpowder to the fire-damp; but Mr. Galloway's experiments show that it is much more likely that the explosion is determined by the noise of the shot being propagated through the galleries of the mine to the safety lamp. An admirable experiment to illustrate this point was exhibited by Dr. Spottswodde, at a recent lecture in the Royal Institution. A lighted Davy lamp was surrounded by streams of coal-gas issuing from a number of jets around the base of the lamp. One extremity of a long tin tube, open at both ends, was placed in connection with the lamp, while a pistol was fired at the other end, a caoutchouc diaphragm being interposed in the tube to prevent the transmission of a direct current of air. The sound-wave, generated by the report, travelled along the tube; and, as soon as it reached the flame, caused ignition of the surrounding atmosphere—the lamp being immediately enveloped in flames.

——AT a recent meeting of the Franklin Institute the following report of a committee to fix upon a factor of safety in carrying steam pressures was made: "The committee to whom was referred the inquiry for some rule for the thickness of shells of cylindrical steam boilers, ask to report: That the subject has been previously investigated by numerous writers, and the general conclusion appears that the 'factor of safety' is ordinarily at 6; or that the working pressure is not allowed to exceed one-sixth of the bursting pressure. Sir William Fairbairn derives as a result of his experiments on strength of materials and of joints: wrought iron plates with single riveted joints, equal 34,000 pounds per square inch, tensile strain, as maximum average strength; and from these data finds the maximum working strength should be 5,668 pounds per square inch. Your committee, from practical knowledge of the thickness assumed by the best boiler makers, think 6,000 pounds more nearly agree with American construction; as the factor of 6 is a large one, and as Fairbairn in his value of 34,000 pounds has made some allowance for reduction of strength in jointing, which may properly be taken as a part of the contingencies that the six should cover, the committee believe that 6,000 pounds can be safely taken for the basis of estimate of the working strength of cylindrical surfaces of steam boilers."

The report above quoted is signed by Robert Briggs, W. Barnet Le Van, W. F. Durfee, and L. Schütle.

——A NOVEL process for surface-hardening steel, which has been devised by Mr. G. Ames, consists, according to description, in subjecting the surface of the steel to be hardened while in motion, to the action of a surface in contact, moving at a very high velocity. If, for example, it be desired to harden the surface of a cylinder of steel, the cylinder is mounted in a lathe turning at the slow motion usually given for turning such a body. To this there is applied an emery wheel revolving at the rate of about 1,800 revolutions per minute. The periphery of the emery wheel is kept in contact with the surface of the cylinder, which, in addition to its slow rotatory motion, has a traversing motion of a little less than an inch to each revolution. At the end of this operation, it is said, the entire surface of the cylinder will be hardened to a depth of $\frac{1}{32}$ of an inch, and so hard that it will resist the action of the best tools made of cast steel, and made in the usual way. Better results, it is stated, can be obtained when the emery wheel can be run at a higher velocity than that above named; and cast iron wheels with smooth faces, or hard substances, may be employed in lieu of emery wheels. For hardening flat surfaces the piece should be mounted in a carriage, so that it can be moved forward in order to present in succession every part of the surface to contact with the periphery of the wheel, or the same result can be reached by mounting the wheel in a carriage having the required traversing motions. Or if the surface to be hardened be of greater width than the face of the wheel, the piece may be mounted in a carriage having one motion, while the wheel may be mounted in a carriage having a motion at right angles to that of the block carriage. If the surface to be hardened be of any form other than a cylinder or flat surface, the form of the periphery of the wheel, or the motions to be given, other than the rotatory hardening motion, must be such as to present in succession every part of the surface to the action of the wheel.

The above described process can obviously be applied to the hardening of the surface of any article made wholly or in part of steel, unless the surface be so irregular that the required motion for bringing about perfect contact cannot be given to it.

——THE following is the system of awards which will be adopted by the managers of the fair of the American Institute—a system which is a great improvement upon that hitherto in vogue at the annual exhibitions of this institution: "1. The 'great medal of the American Institute' to be awarded only to the inventor or discoverer of a machine, product, or process, which shall be adjudged so important in its use or application as to supplant every article previously used for accomplishing the same purpose, or by which a favorable revolution may be wrought in some branch of the useful arts. This medal can be awarded by the board of managers for a machine, product, or process, if actually on exhibition, by an affirmative vote of not less than ten members, after consent of the board of direction is first obtained. 2. The 'silver medal' to be awarded only for a machine, product, or process of great value, and of merit superior to any other on exhibition, or in common use, and then only by an affirmative vote of at least ten members of the board of managers, and upon the recommendation of a majority of the judges. 3. The 'bronze medal,' which may be awarded by a vote of a majority of the whole board of managers, upon a favorable report of a majority of the judges, for a machine, product, or process of superior merit, the best of the kind on exhibition or in common use, but not deemed of sufficient importance to deserve the silver medal. 4. A 'diploma,' which may be awarded for a machine, product, or process, of value, by an affirmative vote of a majority of the whole board. The certificate awarding any medal or diploma must be signed by the president and secretaries of the institute. The board of managers, in addition, is authorized to offer prizes for the best specimens of workmanship and skill by apprentices, and may also grant awards to the exhibitors of cut flowers, fruits, or perishable products."

It is only necessary to add to the above that the exhibition was formally opened on September 10th, and is now in full operation. They are always well patronized, being visited by parties from all quarters of the country; and anyone having a new invention or discovery in the mechanic arts should not fail to send the same to the exhibition.

——THE fact deserves to be generally known that spirits of turpentine is an effective antidote for poisoning by phosphorus. The French Academy has recently awarded the Barbier prize to M. Audant, who, assisted by M. Personne, has carefully investigated the subject.

MONETARY.

SEPTEMBER, the month of panics, adds, this year, one of the most memorable in the financial history of the country. The month opened with the features noted in our previous issue, and the sequences therefrom. The gold premium was advanced a fraction above 16, when the power of the bull clique broke under the load, and the premium receded until it touched 11; so relieving apprehension of another Black Friday. Then followed freedom from excitement, and a sluggish tone, stirred only by the rapid rise in the price of money, under the symptoms of any additional demand; the railroad companies were conspicuous for the high terms they were submitting to. Banking-houses and capitalists, in financial connection with railroad interests, had for some time been apprehensively scrutinized. A New York banking firm went down on the 15th, having heavily endorsed for loans to the Canadian Southern railroad; and as a wealthy and well-known operator was recognized as having a partnership in the house, it was duly proclaimed that "the fabric of public confidence is shaken to its very foundation." Such hyperbole, being of the usual strain, excited no attention; but the "wolf," so long cried out, was at hand. On the morning of the 18th was made the portentous announcement of the suspension of the New York branch of the banking-house of Jay Cooke & Co. (Jay Cooke! no disaster dims the lustre of the great love the name still inspires); the Philadelphia and Washington branches then closed, and instantly, in connection therewith, also E. W. Clarke & Co., of Philadelphia—thence, onward, a financial earthquake. New York and Philadelphia were the chief localities of the upheaval. Twenty-three private bankers of New York succumbed in two days, and a few of Philadelphia. Trust companies and State banks were besieged by frightened depositors, and some in the two cities named, and elsewhere, closed. Generally, the National banks were exempt from suspicion. Prices at the stock exchanges receded from 5 to 30 per cent., and in cases specially affected, beyond 30 per cent. A basis of latent strength began to show itself, however, in all the fury of the agitation, the panic resolved itself into a question of amount of currency, not solvency, and as the currency rests on the credit of the nation, not upon gold, and as the limit of such credit is the resources or capital of the country, no scarcity of the bills could take away the foundation upon which they rested; hence no disturbance of the basis of domestic exchange, and hence the extended ruin of a suspension of specie payment was averted. Merchandise did not fall in price with stock securities, and of the latter the speculative list was in the main affected. Gold, left to itself, scarcely made an advance. A general fall of 30 per cent. in prices is equivalent to 43 per cent. expansion of currency; hence, apart from disturbances in the ebb and flow of the exchange medium, the evil now felt is largely self-corrective, though at heavy cost to debtors. The federal treasury, responding in a limited degree to calls for relief, is buying, without prescribed restrictions as to amount, 5-20 bonds of 1881 at par in gold; but the ability of the treasury to purchase is manifestly not equal to the demand upon it. The currency payments of the government are now over $500,000 a day, while the currency receipts are about $300,000. Hence the government requires a million and a quarter of legal-tenders each week in addition to its currency receipts to make its currency disbursements. Until the secretary resumes his gold sales, he can provide himself with currency only by increasing the legal-tender circulation; and by the 4th of January next claims against the treasury gold will mature, which, added to the bonds and interest already due, will aggregate about $100,000,000, exclusive of the coin certificates.

So far the panic movement has culminated in an agreement by the banks to certify checks of depositors of large amounts, withholding the currency, except for such small demands as will prevent the drain of money from their locality. While general trade shows no marked effect from the disturbance, apart from limited dealings and slight concessions in prices on the part of sellers, foreign exchange being at a deadlock, the shipping interests are almost paralyzed. The New York Produce Exchange has, in consequence, adopted the following resolutions:—

> *Whereas,* The critical condition of the commercial interests of the country requires immediate relief by the removal of the block in negotiating foreign exchanges; therefore,
>
> *Resolved,* That we respectfully suggest to the secretary of the treasury the following plans for relief in this extraordinary emergency: First, that the currency be immediately issued to banks or bankers upon satisfactory evidence that gold has been placed in special deposit in the Bank of England, by their correspondents in London, to the credit of the United States, to be used solely in purchasing commercial bills of exchange.
>
> *Resolved,* That the president and secretary of the treasury are respectfully requested to order the immediate prepayment of the outstanding loan of the United States due on January 1, 1874.

A large number of ocean steamers, now in port, may be obliged to leave for British ports without consignments of grain, which it was expected they would take. New York shippers, who had made engagements for the transfer of a large quantity of grain from the West, being unable to negotiate bills of exchange on their European consignees through any of the regular channels, large quantities of grain have not yet moved East. In other cases, grain and other commodities have been transferred to New York, which now lie awaiting shipment; the local shippers being unable to negotiate bills of exchange on European houses for the payment of freight. It is also said that some of the ocean steamship companies had actually offered to sell their own bills of exchange on the street to get freight, but could not get the prices to warrant them in selling.

——*Sales of Stocks, etc., at New York.*

	Sept. 1.	Sept. 8.	Sept. 15.	Sept. 20.
U. S. 6's, coupon, 1881	119⅝	119	117⅛	114½
" 5-20's, coupon, 1862	117	115	113½	112½
" 5-20's, coupon, 1864	117¼	115	114	113
" 5-20's, coupon, 1865, m & n	118¼	116½	115½	111½
" 5-20's, coupon, 1865, j & jy	117⅛	116	115⅝	111½
" 5-20's, coupon, 1867	119⅛	118	116½	114
" 5-20's, coupon, 1868	117⅞	116½	116	111½
" 10-40's, coupon,	113¾	113	113	111
Pacific 6's, currency	....	113½	113	....
Tennessee 6's	81¼	....	81	....
" 6's, new	81¼	80½	81	....
North Carolina 6's	27½	27½	27	....
" 6's, new	15⅞	15	16	....
Missouri 6's	91¼	....	92	....
N. Y. Central and Hudson R. con	104¼	102⅞	103⅜	89
Harlem	130½	129	128⅜	90
Erie	59½	58¼	57¾	*51
Lake Shore and Michigan Southern	92¼	90½	....	79½
Wabash	68¼	64¼	59¾	38½
Cleveland and Pittsburgh	....	87	85⅜	80
Northwestern	64⅜	59½	59	40
" preferred	82	77⅞	76½	....
Rock Island	108½	105½	105	87
Fort Wayne	....	....	....	....
Milwaukee and St. Paul	50⅜	46¼	46	30
" " preferred	70½	69	68¼	....
Ohio and Mississippi	38⅜	37¼	37⅜	....
New Jersey Central	....	100¼	....	98

* Street quotat'ns

Western Union Telegraph	90⅝	88⅛	89⅜	55¼
Pacific Mail	42⅞	40⅞	43	....
Union Pacific	26½	24⅞	24⅛	16
Adams Express	92	90½	91	85½
Wells, Fargo & Co. Express	73	72	71½	58
American Merchants Union Express	61¼	62	61½	59
United States Express	67¾	67½	66¾	51
Rate for Money	5@6	7	7	....

Sales of Stocks, etc., at Philadelphia.

	Sept. 1.	Sept. 8.	Sept. 15.	Sept. 22.
Gold	112	112⅛	111⅛	112
Sterling Exchange	121⅛	121¾	121	....
Paris Exchange	4.70	4.70	4.68	....
Lehigh Valley Railroad	60¼	60⅜	60½	58
" " 6's	96	96	96	96
" " 7's, reg	98	98	98	97½
Lehigh Navigation	38	37	35¾	24¾
" " 6's, 1884	90	90¼	90	88
" " 6's, g ln	90½	90½	90½	....
" " 6's, reg	....	....	91	....
City 6's, no tax	101¼	101⅜	101⅜	101
" tax	98	98¾	98¾	98
Pennsylvania Railroad	53¾	53½	53⅛	49
" " allot	....	....	....	....
" " 6's, 1 m	100⅛	100¼	100	100
" " 6's, 2 m	....	....	....	100
Pennsylvania 6's, first series	100	100	100	....
" 6's, second series	103	103¼	103	100
" 6's, third series	108⅛	108	108	105
Reading Railroad	55⅛	54¾	54⅛	50
" " 6's, mt	96	96	96	95
" " 7's, reg	102¼	102½	....	100
Catawissa Railroad	....	....	....	....
" " preferred	....	....	42	40
North Pennsylvania Railroad	49⅛	49	49½	....
" " " 6's, mt	99	99½	99½	99
" " " 7's, mt	102	102	101¾	100
" " " 10's, chat	....	....	108	....
United N. J. Companies	122⅛	122	121½	116
Camden and Amboy 6's, mt	96	96	....	95
" " 6's, 1883	90⅝	90½	90	88
" " 6's, 1889	88½	88½	88½	....
West Jersey Railroad 6's	93¼	93	93	90
" " 7's	103	103	102	100
Philadelphia and Erie	24½	24	24	....
" " 6's	89½	89¾	90	88
Allegheny County 5's, coupon	....	....	78	....
Schuylkill Navigation	....	6	6	....
" " preferred	11¾	11½	11½	....
" " 6's, 1882	....	....	91	....
Morris Canal	48	48	48	45
" preferred	122¼	122	120	120
" 6's, 1882	....	94	94	94
Little Schuylkill Railroad	....	46	....	....
Oil Creek and Allegheny Railroad	23	23	22	....
" " " 7's	....	69	....	....
Philada., Germ. and Nor. Railroad	87¾	88	87	86
Minehill Railroad	....	51½	51½	....
Elmira and Williamsport, preferred	....	38	38	....
" " 7's	94	94	94	94
" " 5's	....	....	55	55
Northern Central	34⅜	34	....	....
Rate for Money	6@7	6	6@7	....

NOTING AND COMMENTING.

SPAIN continues to be the central point of interest in European affairs. The Carlists, who were investing Berga at our last writing, were defeated, and the siege raised, August 21; since which time they seem to have abandoned the attempt to reduce the place, and have retired from the vicinity. Bilboa was occupied by the republican army, 12,000 strong, August 22; the Carlist forces withdrawing on their approach without offering resistance. Admiral Lobos began the bombardment of Cartagena on the 23d, but, after continuing the attack for several days, was obliged to retire with his ships to Gibralter—not being able to cope with the artillery of the forts. The siege of Cartagena by the government forces continues, but the besieged communists have made several successful sorties, and a reinforcement of 600 of their friends from Valencia has managed to elude the vigilance of the government forces and join them within the fortifications.—The ministry at Madrid, which had long been accused of incompetency by the republican officers, managed to so thoroughly disgust many of them by a hesitating policy in regard to the conduct of the war, that a number of officers of the army resigned, and several cabinet ministers and generals high in rank threatened to do likewise. Things had arrived at this unsatisfactory stage, when, August 26, Señor Castelar was elected president of the cortes by a vote of 134 yeas to 73 blanks. On taking the chair he delivered a conservative speech. He announced himself a federalist, and called attention to the fact that Germany and Italy, both peaceful and powerful, are tending towards unity and centralization, while Spain is madly rending her nationality. He traced the history of democracy, and declared that the destruction of the republic would involve that of liberty, and that the generation which achieved liberty and failed to preserve it would be infamous. His speech was hailed with enthusiasm by the country, and seemed to infuse some vigor into the government.—Twelve mutineers of the Barcelona garrison have been tried and sentenced to death, and thirty more sentenced to transportation to a penal colony. The cortes, by an emphatic majority, refused to grant amnesty to the communists, and a bill has been introduced by the government drafting all the able-bodied male citizens between the ages of 20 and 35 years. The British vice-admiral, Yelverton, August 31, took the Spanish ironclads Alamanza and Vittoria from the harbor of Cartagena, in spite of the threats of the communists, and sent them to Gibralter.—Señor Salmeron was elected president of the cortes in place of Castelar, and in a powerful speech urged that body to support his successor energetically. A loan has been authorized, and a vigorous warfare to crush out the insurgents of every kind is announced as the policy of the new administration. Meanwhile the communists remain mostly cooped up in Cartagena, and the Carlists seem to be growing weaker, and are nearly all confined to the mountains for want of a cavalry force sufficiently strong to cope with the troops of the republicans.

No important move seems to have been made by either of the political parties in France since our last issue. The reported fusion of the monarchists has outwardly been a failure, though it caused the extreme republicans much uneasiness for a time, and a union between them and the more moderate left centre was canvassed as a means of opposing the monarchists. Ex-president Thiers seems an object of fear to both monarchists and Bonapartists. His movements are watched with suspicion; the more since his recent speech in Switzerland, in which he stated that he had been endeavoring all his life to establish the liberties of France under a monarchy, and had come to the conclusion that the two were incompatibe, and henceforth he was resolved to aid in the establishment of a republic.—The last instalment of the war indemnity has been paid, and France is now rid of the unwelcome invaders.

The Vienna exposition has closed—a financial failure. The deficit in receipts below the cost of the exposition to the imperial government is not yet accurately ascertained, but enough is known to hazard the conjecture that not more than half enough was received to save the government from loss. Out of 30,000 medals of various grades awarded, 400 were to American exhibitors—a result not anticipated after the wretched management of the American department. Much dissatisfaction is reported among exhibitors at the manner in which the medals were awarded, and some excitement was created by the alleged refusal of an English firm to accept a medal of merit.

It has been decided by the British government to send an expedition against the troublesome Ashantees in South Africa. The army will be composed entirely of Fantee warriors, under the command of Sir Garnet Woolseley, and will number 16,000 strong.—Mr. Gladstone seems determined to anticipate the movements of the opposition at the approaching session of parliament, and will offer a "budget" based upon the abolition of the income tax, and if he is outvoted, will appeal to the country. In appealing to the country there, as here, a party cry is essential, and there can be none better than the one proposed.

At this time, when political convulsion are the rule, it is pleasant to behold anything that looks like permanent peace and prosperity. The inhabitants of the Navigator islands, in the South Pacific, have had four years of war, arising from the usual cause among both civilized and savage—a struggle for local supremacy. Late advices from thence bring the welcome intelligence that the trouble has been compromised by the formation of a federative republic, comprising all the islands, with Apia, the principal town on the island of Upolu, as the capitol. The foreign residents and consuls have been requested to form a code of laws, and generally to assist in establishing the new government upon a permanent basis. These islands, from their position and fertility, are a great convenience to commerce, and this termination of the long dispute cannot but redound to the benefit of the civilized world.

——September 10th, the secretary of the navy received a dispatch from the commander of the Juniata, one of the vessels which has been in search of the survivors of the Polaris, dated at St. Johns, N.F., stating that the Juniata met the Tigress at Uppernavik. The latter vessel, after receiving a supply of coal from the Juniata, sailed, August 11, for Littleton island. The Juniata again saw the Tigress at Disco, and learned from Commander Greer that the camp of the survivors had been found at Littleton island. Commander Greer ascertained that the crew had left two months before in a couple of whaleboats which they had built from the upper works of the Polaris, which vessel sunk a month after their departure. They had gone south, in his opinion, for the purpose of falling in with some of the Greenland whalers, known to be in the vicinity of Cape York, and subsequent events prove how correct he was in his conjecture. September 19th, a dispatch was received of the safe arrival of the wrecked crew at Dundee, Scotland; they having fallen in with the whaling ship Ravenscraig, July 20, about twenty miles from Cape York, and been transferred to the steam whaler Arctic, which conveyed them thither. The rescued party numbers fourteen officers and men, who are all in good health. The Tigress is continuing her now unnecessary search.

——A question of considerable interest to populous cities, in regard to the right of the authorities to prohibit armed processions from passing through the streets, was recently decided in New York. Some time since, a pic-nic party which contemplated such a procession to the grounds, was notified that the proposed parade could not be allowed, as the police commissioners had resolved to prohibit all such, for the purpose of preventing breaches of the peace. The question was referred to the corporation counsel, who has lately decided that the commissioners have no authority for their proposed action. This decision, of course, is not final, but under the circumstances is entitled to some weight. It seems strange, however, that the police have not such power, as they can certainly arrest an individual who, by his conduct, is provoking a riot or breach of the peace.

——The amount awarded to this country by the arbitrators at Geneva ($15,500,000) was paid into the national treasury September 9. By the terms of the award it was to have been paid in one year from date, which time expired September 13. In order to prevent any serious disturbance of the money market in either country, operations tending to gradually secure this amount of United States coin certificates have been going on for several months, and have been completely successful. This may be considered a final settlement of all causes of difference between the two countries existing at the time of the award, some of which were upwards of half a century old. Indeed, it is the first time that a balance has been struck between the two countries since this nation had an existence.

——Gen. Wade Hampton, in his testimony before the Anglo-American claims commission, having seen fit to revive the charge that Columbia, S.C., was burned by the federal troops, Gen. Sherman has come forward with a statement to the contrary, supported by evidence which seems absolutely to settle the question. Maj. McArthur and Capt. Goodrell, two of the first three federals who entered the town, make written statements that at the time of their entrance they found confederate soldiers who disputed the passage of the main street by them, and that the street was at that time, for a distance of several squares, lined with burning cotton bales, which had been ripped open and set on fire before their arrival; and that a high wind subsequently arose which scattered the burning cotton in every direction, and set fire to the buildings. Gen. Hampton's own statement is not inconsistent with this testimony, for he acknowledges that he ordered the cotton to be piled in the streets for the purpose of firing it, but subsequently ordered it not to be burned for fear of setting fire to the buildings; but, as he left the town some time previous to the entrance of the federal forces, his orders were evidently disregarded.

——Following close on the cholera, the yellow fever has made its appearance in the Southern States, and rages with a virulence unknown for many years. The city of Shreveport, La., seems the initial point of attack, and before the people of the Northern States were fully aware of its coming, it had exhibited itself in so malignant a form that the inhabitants were fleeing from that locality, and all business was completely suspended. Appeals for material aid have been made, and we are happy to say are being promptly responded to. The disease at this time is spreading rapidly; nor is it abating where it first appeared. Memphis, Tenn., has been visited by it, and the disease, following the track of the cholera so closely, gives ground for the supposition that its virulence is measurably the result of negligent sanitary regulations. New Orleans has escaped its ravages almost entirely since the occupation of that city by Gen. Butler's army, and this is ascribed to the thorough cleansing which it received from him.

——An official statement which has been published shows that the German field artillery fired 331,169 shots during the war of 1870–71. Of this number, 146,144 shots were fired by heavy field batteries, 123,804 by light field batteries, 59,934 by horse batteries, 7,736 by heavy reserve batteries, and 14,380 by light reserve batteries. To the total number of shots as given above must be added 4,460 shrapnel and 430 grape shots, so that altogether 357,237 shots were fired. The number of shots fired by the Prussian artillery in former campaigns was, in 1813–14, 73,881; 1815, 18,086 shots; 1864, 41,247 shots; and in 1866, 36,188 shots.—During the war of 1870–71, says the Vaderland of Munich, the Bavarian troops lost 19 per cent., whilst the loss sustained by the Prussian troops was only 14 per cent.

——As a note to paper in September Review on The Trans-Atlantic Balloon Voyage, we make record here that the project terminated in a fiasco. Mr. Wise withdrew on the eve of the proposed ascension, and the balloon ripped while in process of inflation for the voyage under the conduct of Mr. Donaldson—the result making it questionable whether so large a gas-bag can be successfully inflated.

——The cotton crop for the year just closed was 3,930,508 bales, an excess over that of the preceding year of 956,157 bales. This country consumes nearly half of this product, and the remainder goes abroad.

THE

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ANALOGIES OF LIGHT AND HEAT.

NEAR the close of the eighteenth century, Benjamin Thompson, or as he is now better known, Count Rumford, while superintendent of the arsenal at Munich, was induced to undertake a series of scientific investigations, which led to as important results as perhaps any that have since been made. Noticing the great amount of heat developed during the boring of large brass cannon, he was led to inquire as to its origin. After a series of experiments, which still stand unrivalled for their thoroughness and accuracy, he completely annihilated the advocates of the distinct materiality of heat, and proved it but an affection of matter. Before the time of Rumford, heat was thought to be caused by a peculiar kind of matter, which existed in a highly tenuous condition in the pores of bodies, and the phenomena of heat explained by the taking in or the giving out of this matter; a body, when hot, contained an excess—when cold, a deficiency. The development of heat by compression was compared to the exuding of water from a sponge when pressed by the hand. By this view, the chips from the brass cannon were hot, from the heat being pressed out of them by the action of the borer. If so, their capacity for heat, after cooling, should be very different from that of portions of the cannon that had not been so compressed. Cutting off small pieces by means of a fine saw, Rumford demonstrated that both the metallic chips and the portions sawn off had the same capacity for heat. The heat, then, could not have come from the body; its cause must be sought outside of the body. This step taken, Rumford proceeds to his principal experiments, and we soon find him boiling water by means of the heat developed by the friction of a flat borer against a mass of metal. Without entering more fully into the nature of his investigations, it is sufficient to state that their result, which he communicated to the Royal Society in 1798, firmly established the dynamical theory of heat.

Briefly expressed, this theory regards heat as the result of motion. A body becomes warm when a given amount of motion has been imparted to its molecules; it is cooled when some of this motion has been communicated to the ether outside of the body. Not only have the mutual interdependence of imparted motion and produced heat been proved, but the amount of motion requisite for the production of a certain quantity of heat rigorously calculated. The causes of heat are thus removed from the field of speculation, and rendered capable of almost exact mathematical expression. Progress is therefore rapid and sure.

Our every-day experiences prove to us that light is never produced artificially without being accompanied by heat. Indeed, the same is true of all light, whatever its source. We are therefore led to infer their mutual dependence—to believe that they are but different effects produced by the same force. Like heat, light was once supposed to result from a peculiar fluid, which was emitted from luminous bodies. The difficulties of explaining satisfactorily the phenomena of light by the emission of any fluid, led gradually to repeated investigations concerning its real nature, and finally resulted in an undulatory for light, similar to what we have just described in the case of heat. The causes for the production of the two agents are assumed as the same. Let us inquire, then, into the value of the evidence adduced in proof of the hypothesis. What is the testimony of the simple facts? This subject we propose briefly to discuss.

If a solid body be heated, the only effects at first produced will be the elevation of its temperature and the increase of its bulk. The clashing motions of the source of heat have imparted their movement to the atoms of the heating body, and it becomes in itself a source of heat, imparting its motions to the surrounding media. If, now, the elevation of temperature continues, incandescence occurs, and light accompanies the heat. The mutual dependence of the two forces is therefore fairly inferred. Light must differ from heat only in the energy of the force required to produce it. The molecules of the heated body move faster and faster; the energy of the developed heat rises higher and higher; and at last, when the molecular conflict has become sufficiently great, light results as an effect of motion. It would appear, then, that light differs from heat only in the rapidity of the motions of the molecules of the heated or luminous body, or of the ether surrounding its molecules.

The inability of the eye to appreciate as light, the heat-waves that are thrown off from a warm body, though not understood, should not occasion surprise. The ear offers an exactly analogous case. It is only cognizant of atmospheric vibrations whose rapidity is not less than 16, nor greater that 48,000 per second. All vibrations beyond these limits, either on the side of the less or greater number, fail to appeal to the ear, though they may appeal to some other sense. So with the vibrations that are set up in the ether by the presence of a heated body. Within certain limits they are capable of exciting on our bodies the sensation of heat, but produce no effect whatever on the organs of sight. As more rapid vibrations are excited, their action becomes more and more feeble on the general surface of the body, and begins to exert a faint impression on the nerve of sight. At last, the thermic impression vanishes, and the luminous one alone remains.

Researches in the field of physical optics have enabled us to determine the absolute number of ether vibrations per second required to produce the different colored lights which appear in the solar spectrum. We now know that the red rays are produced by a much less rapid motion of the ether, than are the violet ones, the ratio of the two being nearly one to two; the computed number per second for the red being 458,000,000,000,000, while those of the extreme violet are 727,000,000,000,000 per second! Commencing with the lowest, the colors in the order of their number of waves are red, orange, yellow, green, blue, indigo, and violet, which is also the order of their refrangibilities, from the least to the most refrangible ray. As is well known, the mingling of these prismatic tints produces white light. When the temperature of an incandescent solid is raised sufficiently high, the emitted light is white. These two facts, coupled with our knowledge of the rapidity of vibration of the different colored rays, enable us to make a crucial test of the asserted identity of the causes of light and heat.

When a body has been heated to incandescence, and begins to emit light, the rays first thrown off should always be those of that color which is produced by the least number of vibrations per second—that is, the body should emit red light; and not only so, but the color of the light it successively emits should pass without fail through the orange, yellow, and green, up to the violet. Now, our common experience agrees roughly with these requirements. The light an incandescent body first emits is always a dull red, and in all cases, when the heat is sufficiently high, a brilliant white light results. It was reserved to Prof. Draper to show that all the requirements of the case were rigorously fulfilled. He examined, by means of a prism, the light emitted by a small platinum wire heated by a current of electricity. By increasing the strength of the current the wire was gradually brought to a white heat. When it first grew luminous, the red appeared in the spectrum formed by the prism, then the orange, yellow, green, blue, indigo, and violet; finally, these, by their mingling, produced white, and the wire became white hot. This result shows a wonderful harmony with what we have assumed as true.

Light and heat, then, being the same in their origin, should present analogies in their properties. These we find both numerous and close. When that highly complex series of vibratory forces, a pencil of ordinary sun-light, is passed through a prism and a spectrum thereby produced, the only change that has been effected, so far as we have been able to trace it, is a systematic grouping of the waves according to their lengths, beginning with the red and ending with the violet. Between these an almost infinite number is represented. But, in all cases, the transition is gradual and complete. The separation effected by the dispersion of the prism is unattended with a single instance of a misplaced ray. The complex nature of a light ray, as respects its composition, finds its exact analogue in the case of heat. By passing a pencil of heat through a prism of rock salt, Melloni succeeded in forming a heat spectrum; that is, in proving the presence in heat of a number of rays of different wave-lengths, and in arranging them according to their refrangibilities. This property of heat has been appropriately designated as *Thermochrosy*, or heat coloration. The presence of these different rays is indeed required by the undulatory hypothesis, since those atoms that are constantly increasing the rapidity of their vibrations must be imparting a more and more rapid motion to the ether surrounding them. Instead of the pencil of heat rays, let a beam of light from the sun, or from any other solid heated to intense whiteness, be passed through a prism of rock salt; the heat and light are separated, provided a narrow slice of light has been employed so as to prevent the superposition of spectra. A long spectrum results, consisting of three distince portions, viz.: the luminous spectrum, extending from the red to the violet; the heat spectrum, stretching beyond the red to a distance somewhat greater than the length of the luminous portion, and a part reaching beyond the violet, in which the chemical rays reside; that is, those rays that are the most powerful in producing chemical combinations or decompositions.

When the light is passed through prisms of flint-glass, quartz, water, bi-sulphide of carbon, or any transparent medium, the resulting spectra differ very widely in the relative lengths of their thermic, luminous, and actinic portions; and this brings us to another consideration, in which the close resemblance of light and heat are indicated. A plate of ordinary glass offers no obstacle to the passage of both the heat and light waves from the sun. They pass through the interposed medium with very nearly the same facility as they do through common air. If, however, instead of a beam of sun-light, that from any terrestrial source be employed, then, although the passage of the light is permitted, that of the heat is almost entirely stopped. Experimenting with different transparent materials, we find that they all possess powers peculiar to themselves, as regards their transparency to heat-waves.

These facts might at first thought be deemed as inconsistent with our belief in the identity of origin of the two agents. But when we remember the very considerable differences in their wave-lengths between heat and light, we are forced to conclude, in accordance with undulatory principles, that bodies that are transparent to light need not necessarily be transparent to heat, or, in scientific language, be diathermanous. On the contrary, we find that many substances that are opaque to light are eminently diathermanous; such, for instance, as smoky quartz, blackened rock salt, which permit the passage of nearly all the heat, but completely intercept the light. Again, sulphate of copper is opaque to heat rays, but transparent to blue light. The independence of transparency and diathermancy being admitted, the cause of the varying lengths of the different portions of the spectra formed by prisms of different substances is explained by the absorption of unequal amounts of the rays on their passage through the prism. Rock salt being transparent to heat-waves of all lengths, except the very long ones, forms naturally a long spectrum, while a hollow prism filled with water, from its absorption of the heat rays, gives a spectrum confined almost exclusively to the luminous portion.

The nearest approach to the sun's heat and light, produced by any terrestrial source, is that emitted by the electric light of a powerful combination when caused to pass between carbon electrodes. In experimenting on the relative lengths of the heat spectrum produced respectively by the passage of the electric light and sun-light through a prism of rock salt, Tyndall has shown that the one from the electric light is much the longer of the two. It contains a larger proportion of rays of very low heating powers—that is, of waves of small refrangibilities—than does the sun's spectrum. The explanation is self-evident. The sun's light, before it reaches the earth's surface, is forced to pass through the atmosphere, which, though transparent to the more intense heat rays, absorbs all those of low intensity. The interposed stratum of air being so small in the case of the electric light, all the heat rays pass through to the rock-salt prism. Hence, again, the cause of the diathermancy of most transparent media to the sun's heat; for when the light reaches the earth it has been screened, as it were, of those very rays—viz., those of low penetrating power, that would be intercepted by most all common substances. In his experiments on diathermancy and its causes, Melloni has proved conclusively the influence of screens upon the penetrating power of heat.

And here, then, an analogy between light and heat. When sun-light falls upon objects, its character undergoes a change when it passes off again from the body. A blue glass transmits blue rays, intercepting very nearly all the rest. Colored objects emit only those rays whose wave-lengths correspond to the characteristic tint of the body. All, or nearly all, the remaining rays are absorbed or otherwise changed. Like light, heat is also subject to such changes, being very much affected by its incidence upon or transmission through bodies. As we have already seen, the sun's rays, by their passage through the atmosphere, are deprived of all those of low intensity—a quantity very nearly equal to one-fourth of the whole. Again, a very large portion of the remainder is so changed by radiation from the earth's surface as to be almost totally unable to repass back through the air, and is thus retained for the heating of the atmosphere. Melloni has shown that a bundle of colorific rays, that are only partially able to pass through a thin plate of any substance, have their properties so changed by transmission that, after emergence, they pass almost entirely through a second plate of the same substance. This is indeed as we should suppose, the rays being screened from those that are unable to penetrate the given substance.

An interesting instance of the change in the quality of rays on their incidence, is afforded by those given off from the moon's surface. Unshielded by any observable atmosphere, her surface receives the fiercest radiation from the sun, and yet, when the rays reach the earth's surface, the light only remains. The quality of the rays has been so changed that the heat has been wholly absorbed by our atmosphere. Dr. Wollaston has received the focus of a powerful beam of moon-light formed in a large lens, upon the naked eye, and yet experienced no sensation of heat. A very small quantity of the heat, however, does remain, as Melloni has shown by focusing the beam on the face of a sensitive thermo-electric pile, which showed the presence of a very feeble heat. Bearing in mind that in both these cases the heat was obliged to first pass through the glass of the lens before falling either upon the eye or the thermo-electric pile, it may be that the heat is converted into rays of such low intensity as to prevent them from passing through the prism. The case is still illustrative, however, as it is merely the change in character we are considering.

The undulations or waves that propagate a sound pulse always take place in the direction in which the sound is travelling. This is different in the case of light, where the vibrations are always at right-angles to the direction of the beam. The acoustic wave then partakes of the nature of a longitudinal vibration; the luminiferous wave that of a transverse vibration. From the analogies we have already considered existing between light and heat, we must suppose both these agents to be propagated by the same kind of waves, that differ only in their rapidity. Any considerations, however, that will demonstrate that the heat-waves *must move in transverse waves*, like those of light, will establish more firmly the similarity of their origin. We will show that this can be done. The phenomena of the polarization of light can only be satisfactorily explained by the assumption that the luminiferous waves occur as transverse vibrations. No other vibratory force can explain the phenomena. Now, the polarization of heat-waves has been demonstrated by Berard, and later by Knoblauch, and by Messrs. Provostaye and Dessains. Hence the heat-waves must move as transverse vibrations, else we cannot explain their capability of becoming polarized. A detailed description of the various means employed to polarize heat would here be out of place. Suffice it to say, that almost any of the numerous methods employed for the polarization of light will answer. A single proof of the polarization of heat is all we will adduce. If a beam of polarized light be allowed to fall on a plane mirror, it will be found that at a certain inclination between the mirror and the incident beam the light will all be reflected from its surface, like ordinary light; but that, if the mirror be rotated so as to assume a position at right-angles to its former place, *none of the light is reflected*. The non-reflection of the light from the mirror when in this position can then be taken as the proof of its polarization. The same test may be applied to a beam of polarized heat. A position for a plane mirror is determined by trials, at which the reflection of a beam of heat rays incident on its surface is a maximum. The mirror is then placed in a plane at 90° from its original plane, when, if the heat be polarized, a very great difference should be shown in a delicate thermometer, or other measurer of heat, that is placed so as intercept the reflected rays.

There are in nature certain transparent substances, like Iceland spar, that have a peculiar action on rays of light. A ray of light incident upon a prism of such spar is not only bent out of its original course, but is split up into two rays. The phenomenon is known technically as double refraction, and can be explained by the undulatory theory on the assumption of transverse waves. Knoblauch has shown that a prism of Iceland spar exerts the same influence on a heat ray, dividing it into two separate rays. At a later date, Forbes has demonstrated the double refraction of heat-waves. These facts, then, throw additional light upon the analogies of the two agencies.

Light being a result of motion, it follows, as a consequence of the undulatory theory, that when two ether-waves so meet each other, that their phases coincide; that is, so that motions of the ether particles tend in the same direction, an increase in the motion will be produced, the resulting wave being equal in intensity to the sum of the two meeting waves. The resulting light will also have its intensity increased in the same proportion. Should waves of equal intensity meet in opposite phases, then the ether particles, being solicited by directly opposing forces, will remain at rest; since the tendency of the ether particle in any given direction is exactly neutralized by an equally powerful tendency in an opposite direction. In this case darkness is the physical expression of the absence of motion in the particles of the luminiferous ether. The luminous paradox admits, then, of easy solution: two lights put together may produce an increased light, but they may also produce utter darkness. An exactly analogous phenomenon is known to exist in acoustics, sound-waves, when meeting, either strengthening or extinguishing each other.

Now, exactly similar phenomena have been shown to exist in the case of heat-waves. They may be so superimposed on each other as to produce either an increased heat, or cold, the absence of heat. It has been shown—Fizeau and Foucault have demonstrated—that the same apparatus, that is ordinarily employed to show the interference of light-waves, may also be made to indicate corresponding increases or decreases in the accompanying heat, at places where the light indicates an increased motion or an absence of motion respectively. A short description of the apparatus employed will suffice. A diverging pencil of light is made to fall upon two plane mirrors, inclined to each other at a very obtuse angle. The light reflected from either of the mirrors is then in a condition to interfere with that from the other, and a series of alternate dark and bright bands result. The dark bands mark the complete extinguishing of a light-wave; the bright bands their reinforcement. Now, the accompanying heat-waves also undergo a similar interference, and by means of a very delicate thermometer, capable of showing differences in temperature of the $\frac{1}{400}$ of a degree Centigrade, Fizeau and Foucault have demonstrated that the dark bands have a temperature markedly lower than the neighboring bright ones—an effect which can only be explained by the extinguishing of one ray of heat by another.

Additional testimony respecting the co-relation of light and heat has been adduced by a series of investigations recently made in this country, respecting the changes produced in the color of chemical substances when acted upon by heat not sufficiently great to effect a permanent change in the composition of the body. The result of these investigations reveal the curious fact that the color of a body is different when it is warm than when cold; that a warm body always emits a light whose color is nearer the red, or heat end of the spectrum, than it is when cold. Thus a body which at the ordinary temperature emits yellow light, emits orange, or even red light, when heated to a point far below incandescence. The same body, allowed to cool, again emits yellow light. So green bodies appear yellowish-green when heated; blue bodies appear greenish-blue, or some lower tint. The explanation of these facts is simple, on the the assumption of the wave theory of heat. At the boundary of the red end of the spectrum, on the heat side—a boundary which necessarily varies with the sensibility of different eyes—the vibrating ether molecules require but a slightly increased motion in order to produce the sensation of light instead of heat; while, on the other hand, a very small decrease in the motion will cause them to produce heat instead of light.

Let us now consider the action of heat on the color of a body. It is assumed that color is caused by the waves emitted by the vibration of the molecules; but these molecules are at the same time vibrating so as to produce lower waves of heat, since the body has a sensible temperature. If, now, the molecules are forced to emit heat-waves of a temperature very near the boundary of light, they no longer emit two separate sets of vibrations; but these motions are compounded and produce a resulting wave, whose motion is more rapid than would have been that of the heat-wave, but less rapid than that of the light-wave. This lowering of the rapidity of vibration of the light-waves announces itself by the emission from the body of light of a color whose tint approaches the heat end of the spectrum. When the sensitive body experimented with is already red, the resulting color is a dark brown—a fact in beautiful accordance with the theory, since it witnesses a lowering of the emitted light towards such a point where heat would only result.

BOOKS AND BUSINESS.

THE vagueness of the phrase, "men of business," demands some inquiry how to appropriate it. It is frequently limited to the mere trader, or one engaged in the transfer of products; but in a more comprehensive sense all are men of business—most of us are at work to earn our daily bread—some are nursing property already acquired, and striving for more—a few, wealthy by industry and opportunity, are at work to preserve their possessions. Thus we are all busy—those in poverty, those in competence, and those in affluence. We are all workingmen, and it is a wresting of the words from their true purpose to make them imply that one class of men, as such, are busier than others, and thereby exempt from general requirements. We are not willing to accept the proposition that the merchant or the manufacturer must necessarily be an ignoramus in virtue of his calling; but in the various pursuits of industry there is this distinction—that some lead to an intercourse with books, while others lead away from it. And, for our purpose, the "men of business" are all those whose engagements in active life are not connected with habits of reading. The subject is not peculiar to one class; the members of every department of business—mechanical, commercial, or what were once styled the learned professions—have an interest in the discussion of neglected literary opportunities. There is a vast field of thought, unknown to the most, open to all; and the merchant, whose mind traverses only on the highways of traffic—the lawyer, whose reading is not enlarged beyond those books which are but the tools of his craft—or the physician, whose mind dwells wholly on patients on his list or in expectancy, is cramping *himself* within closer limits than are healthy to his individual powers or worthy his *vocation*. Nor is the subject peculiar to one sex; it is of deep interest to those whose domestic cares may aptly be blended with a communion with books. While, therefore, words have been employed intended to avoid the ambiguity of a more general expression, let it not be supposed that any exclusive sense is contemplated.

That there are many persons who have strengthened and enlarged themselves by the best use of the literary opportunities open to them, we are well aware; but there can be no doubt that there is a large number whose use of books or other instruments of knowledge is not habitual, whose reading is only occasional, suggested by accident, caprice, or fashion—confined to the lightest forms, to superficial news, or resorted to only in the last extremity, when other plans of amusement fail. If this were the effect of weakness of intellect or frivolity, it would be folly to argue against it. But such is not the fact; for every one may observe, even in the circle of his own acquaintance, men and women of sound and often vigorous minds, in this predicament of mental barrenness, or else with tastes bounded within some narrow province of letters. Now, why is it, that what is intended for all, finds an avenue to the minds of only portions of society? Let it be remembered that what is usually entitled "literature" is addressed to all; it is not technical—it is not professional. Using the thoughts, it disclaims the dialects of science and art; it clothes itself in the common language of social life. It recognizes no sect, no calling, but comes to us all in the familiar accents of our mother-tongue. Why is it, then, that so many are lingering on the frontiers of this public domain? There are various causes—some at work imperceptibly. It is our design to show that all which we are able to detect are exaggerated beyond their real importance.

We have no hesitation in asserting that any person, man or woman, with an average amount of intellect, and with learning enough to read a newspaper, has the whole region of literature lying open to him, or her, and entering it, will grow in capacity to occupy it. That individual who does not realize this, has faculties in him that he knows not of, and which will become decrepid from disuse. Yet the influences of these causes are natural. Accident, early taste, the nature of a profession, may make some men habitually readers of books, but it would argue monstrous folly to make that a pretext for superiority over others whose habits had taken a different bent.

The foremost obstacle to the cultivation of habits of reading is probably the want of time. The man of business may allege, that when he rises in the morning he hastens to his work; that he knows no intermission except for his meals; that night comes on, and the season of sleep, not too early for the repose both of body and mind, alike exhausted by the labors of the day, and the succeeding day brings with it the same round of toil. From another quarter, consumption of time in domestic and social duties may be hinted at. But can he rescue no fragments of time? Is it not more a matter of defective self-discipline than of over-occupation that a few minutes cannot be intellectually utilized each day? And as more often comes from so occupying minutes easily than so occupying hours laboriously, the value of such minutes should not be depreciated. The amount of reserve time varies, of course, with the nature of different occupations. The business of many is prescribed within certain fixed hours, as is the case with a great class in every commercial community; that of others extends over the whole day. Again, some seasons are attended with great press of activity, while others are left to comparative inactivity. Speaking generally, it may be assumed that the labor of most men of business is properly labor of the day, not intended usually to encroach upon the hours of the evening. Let anyone make the simple experiment of accurately observing how his time is disposed of, and after liberal allowance for business, rest, and amusement, there will be found a surplus of spare time, which may be rescued by the determination not to allow it to be frittered away.

But the leisure time of the man of business, the remnant after the day's toil, is perhaps considered too uncertain and too inadequate. A cultivated habit of reading is regarded as a sort of privilege. "Men of letters," as they are called, are looked on as a peculiar class, and thus the erroneous notion is strengthened that it is in vain to attempt the formation of the habit, unless a large amount of time can be devoted to it. Let the effort be made, and it will be found that there is ample time for even extended courses of reading, and that there is no better mode of renovating the spirit, worn and wasted by its daily toil. In truth, the usual difficulty is to provide for the periods of leisure.

Now, this brings us to the real obstacle, which is to be traced to a more remote cause—the absence or weakness of a taste for reading. It would be uncandid to palliate this difficulty, the existence of which cannot be doubted, though we believe it to be exaggerated. It is indeed true that a literary habit cannot be formed at will; it cannot be gained by the hasty impulse of an unreflecting fancy, to be as soon abandoned for some new caprice. The love of reading, like every other valuable principle, demands effort for its formation. Without it, leisure and access to books are of no avail; a man may famish for the want of appetite. If, however, the selection is limited to books of a frivolous character, it is contributing to a result directly opposed to a healthy taste, because such works have no tendency to stimulate a spirit of inquiry and observation—the good fruits of true reading—but rather to decoy the mind away from much truer enjoyment. Rising to a higher order of books, though still of a popular character, it will be found that the reading of one book naturally leads to the reading of another; the reader is thus prompted successively from one mental acquisition to another.

The feebleness of literary taste may be ascribed, by some who are conscious of it, to the defects of early education; and it may be thought as impossible to retrieve what is thus lost as to beckon back the days of childhood. This difficulty is also no imaginary one; but while it shows the importance of fostering in early life a taste for reading, it ought not to extinguish the hope of a later day. We would not write one word that could be perverted to the disparagement of systematic instruction; but the most zealous advocate is not bound to be so blind a partizan as to maintain that the sphere of education is of no greater compass than mere tuition. There is no word in the language of more indefinite meaning than the word "education." Though deeply impressed with the importance of the customary methods of fashioning the mind, we do not hesitate to avow the belief that they are not absolutely indispensable. The resource of self-education, which is the paramount education, is withheld from no one; the pursuit of knowledge under difficulties is knowledge in companionship with a great teacher. Bacon, with that adroitness of words which so completely invested and expressed the fulness of his thoughts, said: "Studies themselves do give forth directions too much at large, unless they be bounded in by experience." Hence the man of business is on the right line from which the mere student is withdrawn, and hence the man of experience has advantages in his reading which the follower of mere words has not.

An objection is presented that literary habits conflict with habits of active usefulness. This prejudice may be traced to very different sources. In the first place, men, illiterate and uncultivated, are successful in the world, and build up for themselves large fortunes. In some cases, when literature is spoken of, such will reply that *they* never felt the need of it; that there is no better or more productive reading than the "market reports," and that for every man of letters you make, you spoil a man of business. Now, what does all this prove? It may, indeed, disprove what has not been asserted, that literature is essential to the acquisition of wealth. But, is it not obvious that it does not, in the smallest degree, prove that literature presents obstacles to worldly welfare? It may prove that ignorance, and vulgarity, and riches, sometimes consort together. It does prove the existence of that human frailty, illustrated long ago by Æsop, which leads one creature to set himself up for the standard, and to persuade his fellows that the properties which he does not possess are useless and injurious excrescences. All that is incumbent on us to establish is, that between a well-regulated habit of reading and the most active habits of business there is no incompatibility. The fondness for reading may be abused, and so may every feeling and appetite. Men may eat too much, they may drink too much, they may sleep too much, and in like manner they may read too much—even think too much. Whenever one principle ot our nature is indulged at the expense of another, an unhealthy and unnatural condition, whether of mind or body, is the result; and it is a lamentable error, insinuating itself deeply into the opinions and practice of men, that when an individual enlarges his mind beyond the immediate requisitions of his daily work, he unfits himself for the faithful discharge of that work. Thus it is that men dwarf themselves into mere specialists or plodders, as if the whole object of our being were involved in the accomplishment of a set task. We would not incite any man to withdraw a single moment from his proper calling, still less seek to excite in the mind of any woman a distaste for the noiseless but precious duties of her sex. It is far, too, from our intention to argue against the love of money, as contrasted with the love of learning. The love of money is a passion, liable, indeed, to fearful abuses, but still a rational and laudable passion; and there is no more spurious virtue than what is often commended as a generous contempt for money. It is most equivocal praise which we hear sometimes given to men who are said not to know the value of money—an ignorance which refers quite as often to the property of others as to their own. It is our aim to show that the prosperous discharge of the duties of honest industry may be united with ample devotion to literary pursuits. We would root up the wretched prejudice which would bind down the aspiring spirit of man to the atmosphere of his daily craft. There is for everyone an appropriate sphere of action; but no one exists for that alone, no matter how elevated it may be. Men do not live in order to be lawyers, or merchants, or physicians, but their professions are only means by which they strive to attain some object—wealth or fame, or both. It would be easy to refute the error by showing that habits, not only of reading, but of authorship, and even the cultivation of the least earthy of human powers, high imagination, may harmonize with the common drudgery of life. When our thoughts turn to the names of men illustrious in letters, we are apt to think only of so much of their occupations as has served to perpetuate their memories, and to forget that they had their every-day work, like the rest of us. We do not reflect, for instance, that Chaucer and Spenser and Milton were clerks in the public service, and they were faithful to their trusts. Shakspere was the thrifty and thriving manager of a theatre, as well as an actor, and we may infer that he was a man of business; and Charles Lamb earned his peculiar reputation during three and thirty years' service as a merchant's clerk, bound, to use his own feeling language, to "the desk's dead wood."

It is a familiar truth that the happiness of life is made up of its little incidents, rather than of more conspicuous events. Now, there is nothing more fatal to happiness than an incapacity to provide for unoccupied time. Besides the ordinary intermissions of daily labor, there are intervals of occasional leisure incident to every occupation. Even the common occurrences in travelling, whether for business or pleasure, will often throw you upon your own resources. Common pleasures may be cut off by a tedious indisposition or the neutral ground of convalescence. Solitude in various forms may be forced upon one, and miserable is the state of that person whose habit is to depend entirely upon external support. Exactly in proportion as the habits of reading are cultivated, will the dangers of idleness and the pains of listlessness be diminished. Every day—the rainy as well as the bright ones—will show how strong, how happy, how independent one may be in the companionship of books.

The tendency of active life is not only often to conceal some of the purest elements of human nature, but to bring into undue prominence many of the worst. The angry passions are seen in ceaseless conflict: the lust of power, corrupt and malignant party spirit, the insatiable thirst for money, the fierce contests of vulgar-minded men, are spectacles that the sun shines on daily. There is nothing easier than to become a misanthrope. Looking at the picture of life on the dark side, men become cynical; they seat themselves in "the seat of the scornful." The hopefulness of even the pure in spirit sickens, for they behold the generous and confiding betrayed, the open-hearted victims of their own frankness; kindness returned with ingratitude; modest worth patient under the usurpations of falsehood and of impudence; and thus virtue is thrown back upon itself. While the feelings of the man of the world are thus embittered by the strife of the angry and little passions, the student can refresh his spirit by contemplating the purer passions that move in a loftier sphere. The worst passions lie on the surface, seldom slumbering, and always ready to start into action; the truth of their existence is the sad lesson we are taught by the world; the equal truth of the existence of our nobler emotions we may learn from communion with the wise and good on the pages of books.

The easy access to books at the present day is too familiar for comment. Embarrassment of an opposite kind arises from the inordinate increase of publications. At a period when there are thousands of authors, and tens of thousands of critics, there is danger of being bewildered in the crowd. The mind is oppressed with the conception of the number of books, and still more alarmed at the prospect of the rising flood. It is a question if it were not a merciful providence that the art of printing was not earlier invented and brought into use. It is erroneous to suppose that for ordinary purposes a great number or variety of books is needed. A collection of twenty, or even fewer volumes might be named, which would serve as fast and never-failing friends in a course of three or five years' reading.

True literature, applied to its true purposes, will leave no hour weary; it tranquilizes the cares and the asperities of business; it fosters the sympathies of society; and, more than all, it crowns the love of home. Relying on a habit of reading, rather than common amusements, one finds the heart more equally sustained; a permanency impressed upon the feelings; the freshness of youth carried forward into the maturity of manhood; a harmony given to the whole life. With true literature for a sometime companion and guide, neither commerce nor politics can destroy the vigor of imagination, or make callous the poetic sensibilities. With it the imagination may be exercised and beautified, the finest susceptibilities be kept alive without impairing the practical judgment and executive powers—without unfitting a man for the world.

LOVE AND THE TOURNEY IN THE LOWER ANIMAL WORLD.

(DARWINIAN PSYCHOLOGY.*)

UNCONSCIOUSNESS is deemed a pervading characteristic of natural selection, despite of the contradiction involved in the terms. The choice is supposed to be made blindly, the animal answering only to the prompting of individual conservation, but such theory is not sufficient to explain the acquisition of certain corporeal advantages and mental faculties which are not necessary in the actual combat of life. The males generally possess as special privileges a larger form, greater vigor, and a belligerent disposition; arms offensive and defensive, bright colors, varied ornaments, the power of song, and odorous emanations.

What, then, were the intentions, so to speak, of Nature? The more we observe, the more will we be assured that the adjuncts named are not necessary for individual preservation; for, without weapons and ornaments, the females not the less easily subsist and reproduce their species. When we view two males in deadly combat, in presence of the companion who is to be the prize of the victor; or rather, when we see several males displaying the splendor of their adornments, and practising the most grotesque attitudes and gestures before an assembly of females, judges of the tournament, what must we conclude?

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* Origin of Species; Descent of Man; Emotions in Men and Animals. By Charles Darwin.

One cannot believe that these animals, although obeying only an imperious instinct, know nothing whatever of it, and are exercising their capacity in an unintelligent manner. And the attitudes and coquetry of the males—this pride of adornment and studied exhibition of their several advantages—imply a reciprocal aptitude in the female to discern what is worthy of admiration, and a faculty of choice in the diversities of attraction which follows its own law.

Males and females have, then, the characteristics and faculties which attract, discriminate, and respond to another. There is a choice, which is the sexual selection, and the effects of it are very important. As is well known the breed of fighting-cocks can be improved by crossing with those which are victorious in the arena. For the same reason, throughout all nature, the strongest and most belligerent males, or those most successful in the pacific art of enticement, have prevailed, and through them the improvement of the race is accomplished. Their advantages, though perhaps small at first, are increased by hereditary transmission, purified by the murderous elimination of rivalry.

The effect has been an improvement, with some variations, which has gradually consummated the work of sexual selection, in raising species not only more beautiful, but even new varieties. To this magnificent result the females have contributed their full proportion, since, guided by an exquisite sensibility, they for a long time had chosen such males as were most endowed with attractive qualities, thus constantly adding to the beauty of their offspring. The two sexes, therefore, should have—and though the affirmation may appear surprising, they in reality do have—the æsthetic faculty; the males being conscious of their own beauty, and at will making a display of it before the dazzled eyes of the admiring females; the latter fully able to perceive and recognize this beauty—to choose it, and transmit to future generations.

At the lowest degree of the zoological scale science can prove the existence neither of sexual selection nor of æsthetic faculties. In the inferior classes of animals, the two sexes being often united in the same individual, there can be no progressive development of distinctive characteristics. In other cases the sexes are separate, but, the animals being fixed in a permanent manner, are incapable either of offering attractions or of striving against rivals. The Mollusks, Annelides, and inferior crustaceans, do not furnish decisive observations as to sexual selection.

Among these creatures, so poor in organs and faculties, the characteristic differences of sex are either null or feeble, perhaps scarcely appreciable—not, however, but that some interesting particulars and exceptions can be found. We cannot but note with Agassiz the amours of the snails—the assiduous wooing which precedes their final pairing. Therefore, if a reciprocal choice on the part of earth worms, or marine mollusks, is conceivable to a certain point, this voluntary selection is outside the region of probability.

The Arachnidæ are much more subject to sexual attraction and repulsion. In some species of spiders the difference of color is very marked; pale green, bright yellow, and red, adorn the bodies and articulated members of the adult males. All spiders show much intelligence, and have a certain look of malicious mischief; their females also manifest the utmost affection for their eggs, which they cover with silken envelopes. Their senses are exceedingly keen, and some species of Theridons produce a harsh sound which the females hear and understand. There appears, therefore, to be some reason for believing that the colors of spiders are the result of sexual selection. Doubts exist, however, on this subject; their slow and prolonged assiduities rendering observation very difficult, and their amours often have tragic ending. The naturalist Geer saw a male, who, amidst his seductive caresses, was suddenly seized by the object of his attentions, enveloped in her silken web, and incontinently devoured.

The pairing habits of other insects are more easily discovered, and among them the theory of sexual selection meets with facts which seem to be conclusive. We are rather inclined to ignore the beauty of insects on account of their diminutive size preventing our seeing with ease all their various attractions. If one could imagine a male Chalcasome, with his bronze coat of mail and great complex horns, in proportions as large as a horse, he would be one of the most imposing of all the animals of the world. Such as we may view them, however, the insects are full of belligerent spirit. Two crickets, if shut up together, will fight until one of them expires; and the mantes know how to manœuvre skilfully, using their anterior members as a hussar would his sabre. Butterflies, in combat, circle round and round, striving to give mortal blows, and it is almost always a female which is the prize of the struggle. The latter, as with the Cerceris, for example, views the duel with apparent indifference, but she awaits the victor and flies tranquilly away with him, as if touched by the beauty of warlike virtue.

None but the brave deserve the fair.

Still more sensitive to pacific attractions, the female insects understand and are moved by the sweets of melody. When the tropical forests resound with the notes of the grasshoppers; when the Fulgorides, those nocturnal minnesingers, vibrate the resonant apparatus with which they are provided, they are then palpitating, says a naturalist, the summons of love; the females are attracted and pirouette around the performing males. Sometimes two or three artists, at a distance from one another, will sing successively, like the shepherds of Theocritus. Amyryllis hears, judges, and chooses the most accomplished musician.

Wanting in musical power the butterflies have, as compensation, a splendor of coloring above that of any other insects. No language can describe the magnificence of some tropical species. This richness of shades and designs is not always the exclusive privilege of the males. There are some species whose females have wings adorned more brilliantly even than the males, and sometimes there is no difference. When there is, however, as a general rule, the male is the most beautiful, and most exceeds the average color of the species. The butterflies are conscious of their beauty, for they display it. In fact, as the upper surface of their wings mostly offers the greatest charm, it is that which is the most shown; and the insect can be seen, when in repose, executing gentle movements with its wings, which seem to have no other intention than to cause its ravishing adornments to be admired.

On the contrary, the Geometrides, and the Noctueés Quadrifiés, in whose case the inner portion of the wings is more variegated and brilliant than the upper part, turn the organs of flight over on their backs, and keep them in that position a certain time, as if to exhibit the handsomest portion. But there are other proofs of admiration among insects, and also that they distinguish and choose colors. The sphinx notices afar off a flower that pleases it, and alights without hesitation on the desired bouquet, and it will sometimes even enter apartments, attracted by brilliant flowers represented on the hangings. It is this capacity of admiring beautiful colors, both on its fellows and on flowers, which gives almost certainty to the idea of sexual selection under such conditions. With any other hypothesis the marvellous ornaments of the butterfly would seem to be without a sufficient object, considering nature simply as an aggregation of successive means to ends.

If the insects are apt to discern degrees of beauty, fishes are equally so, and with more reason, for Mr. Darwin affirms that they possess a relatively high mental organism. He cites the delicate sensibility of the stickle-back, the martial bravery of the salmon, and the paternal solicitude of the Geophagus and Pomotis. It is true no direct observation demonstrates they actually possess the æsthetic sense, but a multitude of facts demands that it be attributed to them. At the time of spawning, and consequent choice of mates, the bodies of most of the males shine with dazzling splendor. The male salmon is marked on the gills with orange bands, and the pike of the United States shows changeful and rainbow hues of an extraordinary depth of tone. On the contrary, after spawning, when the time of seductive influence is passed, the colors fade, and the phosphorescence pales. But still more, if a fish be conquered in a combat of love, suddenly at the same time its pride falls, the former beauty declines. These flowery hues exist solely, or at least seemingly so, as splendors destined to dazzle the female, who understands their value. Sometimes, however, the *rôles* are changed, and the attributes reversed. Certain exceptional female fish are as brilliant in colors as the males are modestly adorned. But this is of small importance, for in such case the æsthetic quality is reversed; it is the male who admires, and it is he who chooses.

As for birds they seem to almost prove the theory of sexual selection. According to Mr. Darwin, they are, of all animals below man, those in whom the æsthetic sentiment is the most developed, and approximates most nearly to that of man. All male birds are belligerent, fighting with beak, wings, claws, and spurs, of which we have ample proof in the spring-time among the red-breasts and sparrows. The humming-birds, the smallest of all, are the greatest quarrellers. M. Gosse saw two of them seize one another by the beaks and whirl around, fighting in the air, till they fell panting and interlaced to the ground. While generally the combats are a deadly struggle in presence of, and for the conquest of the female, others seem only shams, arranged to display the advantages of the males before their companions, whose choice is guided by their admiration of the heroic qualities and beauty of the suitors. Yet here again all is not strife or the appearance of it. Vocal music—the song, with its diverse notes and graduated modulation—is one of the principal means of persuasion with the bird.

Montague who was a very exact observer, says the male singing bird does not seek the female. He perches in some conspicuous place, exhales amorous melody, and the female, which recognizes the call, flies toward the musician, if he has sufficient power to charm and attract her. Bechstein, who has reared birds all his life, asserts that the female canary always chooses the most able singer; he adds that, in the state of nature, the female finch can distinguish among a hundred males the one having most musical talent. The case is cited of a bull-finch, which had been taught to whistle a German waltz, being introduced into a room where there were captive birds, and executing his favorite air, female linnets and canaries approached and listened with the most curious attention.

Certain males also show extraordinary ardor to conquer their rivals in a combat of song; and such a bird, thus gifted, has been known to so exhaust himself by singing as to fall suddenly dead. It is important to notice that the musical aptitude of birds is most manifested during the months of pairing. The same may be said of their desire to display the ornaments—often magnificent—with which they are adorned. They execute dances, parades of love, and rhythmic marches, during which an innate gallantry makes their supple forms undulate, and their crests and plumage changeful in hue. There are some which even construct on the ground arbored gardens, adorned with feathers, shells, and leaves, in whose shadows they seek to retain and charm the object of their affection. These are in reality pleasure houses, for the nests are placed high above on the trees.

Other means of wooing among birds are marvellously numerous, but they know that they possess them, and they use them with infallible art. The Tragopan pheasant dilates at the proper moment the shining crest on his head. The African calao swells the scarlet caruncle of his neck, at the same time that he distends his tail-feathers and trails his wings like curtains.* It is certain that, with many birds, the plumage of summer is only a nuptial ornament, and this fact associates the æsthetic sentiment with the mating in the case of the male as well as of the female.

Ascending from birds to mammiferæ, the theory of sexual selection, founded on the power of the æsthetic sense, should acquire increased probability. The reader who expects it, however, will be somewhat disappointed. The facts here are less remarkable, and do not present themselves with ease in similar groups. They appear often to trouble the ingenuity of Mr. Darwin with doubt and perplexity, but he remains true to his theory, and still defends it with dexterity and address. Here is one grave countervailing fact. With the mammiferæ, he says, the males appear to obtain the females much oftener by the courage displayed in combat, than by exhibitions of ornaments or charms. This is rather surprising, for as intelligence increases, brute force seems to predominate, and it appears strange that such a contradiction did not more particularly strike the able zoologist. However it may be, his argument suffers, and his conception of the subject is sensibly weakened.

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* To the above instances might well be added the pictures from any farm-yard of the billing, cooing, and strutting of pigeons, the evident grotesque conceit of the turkey gobbler, with tail full spread and quivering, and the calm, aristocratic vanity of the peacock.

In general, the males of the mammiferæ exceed the females by visible advantages. Their horns are longer, stronger, and sharper; their weapons of defence more powerful, their forms larger, and their muscles more vigorous. Some of them have manes, which the females have not; and when it happens that both sexes have them, that of the male is much more thick and abundant. These are so many means of defence, useful in the combats in which the mammalia, large and small, indulge during the season of procreative ardor. But this is not the only use of the mane, for it protects the animal not only against his rival in love, but also against ordinary enemies, as the mane of the lion assists in his defence when attacked, as he often is, by the tiger. The bull defends the herd with his horns, and the elan of Sweden can kill a wolf with one thrust of his long spears. When these appendages grow to such height as to become embarrassing and entangle at times in the underwood, we may infer that they then ornament the male, in order to render him more attractive to the female. Mr. Darwin thinks so, but at the same time he candidly acknowledges he does not know of any facts to support the opinion. The theory thus loses one whole order of proof.

It is not less uncertain in regard to the preference manifested in pairing, sometimes by the male, and sometimes by the female. The arguments on each side seem balanced. The general impression among those who raise animals is, that the male will choose indifferently any female. The information on points of this nature which can be gained from wild animals is not sufficiently accurate; and we must, to be more exact, observe domestic animals.

But here the experience is necessarily less conclusive, for it is the primitive and natural instincts with which we are concerned, and not the inclinations modified by domestication. Therefore, although the celebrated "Monarch" would never consent to pair with the illustrious mother of "Gladiator"—although the stallions of pure blood be disdainful and difficult in the highest degree, and if it has been found necessary to deceive some high-bred mares before they would agree with a horse they had not chosen—the question still remains obscure.

We have traced in its principal lines the Darwinian doctrine of sexual selection. In its final analysis we can see it rests on this essential fact, that animals—sometimes the male, sometimes the female, and at times both together—are sensible to the attraction of beauty in one another. That they may be reciprocally struck thereby, we admit; but we inquire, whether this beauty of color, form, or song, be really chosen for the beauty alone; or this grandeur of color, force, or melody, are they not for the animal expressive, but exclusively brutal signs of a physiological state which the instinct awaits, which it provokes, and to which it responds? This is the whole question, which it is necessary, if possible, now to unravel and solve.

THE CIRCULATION OF WATER ON THE SURFACE OF OUR GLOBE.*

WE live at the boundary of two oceans—the atmospheric and the liquid ocean. The extreme limit of the former is inaccessible to us, for the highest mountains are only shallows in the depth of its currents; of the latter, only the surface is known, while the secrets of its depth, and with them the greatest part of the solid surface of the earth, are hidden from our view. It is true that mighty masses of land project above the sea, and the solid basis of the atmosphere is to its liquid basis as 51 : 146; but the conception has long been abandoned that the elevations over the sea-level would be sufficient to fill out the gap which would break up the outline of the earth, if we could succeed in completely drying up the ocean. Humboldt determines the mean elevation of the continents as approximating 1,000 feet above the sea-level, while Bache calculates the mean depth of the Pacific at 14,190 feet—a depth which, of course, is considerably exceeded in the deepest places; for Ross found in 15° 3′ south latitude, and 23° 14′ west longitude (Greenwich), no bottom at a depth of 27,600 feet; Denham, on the vessel Herald, in the south Atlantic, only at 46,000 feet; while Parker, on the frigate Congress, near the same place, did not succeed in finding any at a depth of 50,000 feet. Brooke, also, made soundings in the Indian ocean to a depth of 42,240 feet—an ocean in which already the ancient navigators had designated a place at the mouth of the Hoogly, in the Bay of Bengal, as "the bottomless pit." But, even if we imagine all seas and rivers actually dried up, we would yet be mistaken in thinking that we should then have to deal only with a solid mass. For the temperature, which rapidly increases towards the interior of the earth, leads to the conclusion that at a comparatively small depth, that which is solid at the surface becomes liquefied in the glowing heat of the interior; that the solid crust surrounding this glowing liquid bears to the latter not even the same proportion of thickness as an egg-shell to its contents—nay, that it is so weak as to justify the opinion which has recently been expressed, that this crust could not bear as heavy a weight as the Himalaya range, and that the latter is floating on the liquid internal ocean as ice on water—a mighty berg, indeed, since it projects to a height of about five miles above the surface of the external ocean. This suggests, then, the opinion that the excess of the liquid over the solid in former times was greater still; that, indeed, in those times the whole earth was in a liquid condition.

The fundamental property of a liquid is the easy movability of its particles, which obey every force that impels them to motion. If no external force acts upon such a liquid, its single particles are under the exclusive influence of their own mutual attraction, and it consequently assumes a globular form, because this form most corresponds to the condition of the greatest approximation of all single parts. If water falls, gravitation can exert no plastic influence upon it, since all parts of a falling body move with equal rapidity. This becomes still more strikingly manifest if we pour oil—which floats upon water, but sinks in alcohol—first into alcohol, and then add enough water to impart to the mixture of the heavier water and the lighter alcohol the exact density of the oil. The latter then contracts into a perfect sphere which floats freely in the transparent mixture, as the earth in universal space. If through the cover of the square glass-vessel containing the mixture a wire is introduced, to the lower end of which a perpendicular metal-disc is attached, it is easy to approach the oleaginous sphere to this circular disc in such a manner as to cause it to completely surround the latter. If, now, the wire is made slowly to revolve around its axis, the inner disc sets the sphere in motion, and thereby changes its shape into that of a spheroid; while, with a greater rapidity of motion, the oil separates and rotates as a ring around the axis of rotation. If the second experiment illustrates the origin of the ring of Saturn, the first one explains how the formerly liquid earth received its spheroidal shape, and how the ocean exhibits this shape in its purest perfection, while the uneven outlines of the land allow it to become less distinctly manifest. If we refer our own motions to the centre of the earth, we therefore are so much the more distant from the latter the more we approach the equator; and, indeed, the mouth of the Mississippi is farther distant from the earth's centre than its source. Those who are fond of paradoxes may therefore say that this mighty stream flows up-hill. But, of course, in order to judge the descent of a river, its surface must at all places be determined according to its distance from the sea-level in its respective latitude—*i. e.*, according to the position the water would assume in connection with its mouth, in a state of rest.

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* Translated for the American Exchange and Review, from the German of H. W. Dove.

We have compared the earth to a falling drop. This is, however, no mere comparison, but an actual reality; only the fall of this drop is directed towards the sun. We use here the expression "fall" in Newton's sense, according to which gravitation exerts its influence upon moving matter in the same manner as upon matter in a state of rest. If, standing on the surface of a frozen lake, we fire a ball from a rifle held in an exactly horizontal position, and at the same moment drop another ball out of our hand, they will both touch the surface of the ice at the same moment. However rapidly, therefore, the powder may impel the ball onward, it cannot resist the influence of gravitation, but falls exactly as the ball upon which the powder exerts no influence. The earth may be compared to a ball thus propelled by powder, which, without the influence of the sun, and when once in motion, would move on in a rectilineal direction. But the sun does not suffer this to take place; it always compels the earth to fall from the tangent towards itself, and thus converts its rectilineal path into a circular orbit. But the effects of all forces diminish as their distances increase. That part of the liquid earth which is turned towards the sun therefore falls farthest from the rectilineal tangent, its centre less far, the point on the opposite side the least, and in consequence both points are removed from the centre. This gives to the liquid earth the shape of an elongated spheroid, the longer axis of which is turned towards the sun. On a solid earth, the cohesion of whose particles prevents a change of their mutual relations, such a metamorphosis cannot of course take place; consequently all its particles move like the centre, since the particles lying before the centre hasten its motion in the same proportion as those particles lying behind retard it. Now, since the earth is neither entirely liquid nor entirely solid, the liquid water will assume a spheroidal shape upon the unchangeable solid sphere; *i. e.*, it will accumulate at the points turned towards and away from the sun, and flow off the sides towards both places. If the earth were not revolving around its axis, the sea at those two places would at all times become deeper, while being shallower at the sides. But, as the earth revolves, the tide-producing body changes its position, before the spheroid which it tended to produce in the liquid covering of the earth has been fully formed. This produces a wave which follows the luminary in its apparent motion around the earth. The liquid spheroid remains stationary, therefore, over the solid sphere revolving under it, and consequently every place comes twice within each day—viz., at noon and midnight—to the place of the deepening ocean, and twice—at 6 A.M. and at 6 P.M.—to the place of the shallower water. This phenomenon is called the ebb and flow or rise and fall of the tide.

We have thus far considered only the sun without referring to the quiet satellite of our earth, the moon, to which the earth bears a similar relation as the sun to the latter. But all attraction is mutual; therefore the moon does not only fall towards the earth, but the earth towards the moon—*i. e.*, it moves more rapidly when the latter precedes it in its orbit, more slowly when the moon follows; it turns sideways out of its orbit when the moon takes an intermediate position. For the same reasons, therefore, which cause the sun to produce a tide, the moon likewise has the same effect. If all three bodies occupy a position in line—*i. e.*, at the times of the full or new moon—the solar tide occurs at the same place as the lunar one; the water consequently rises higher, because attracted by both bodies. If the three bodies form a right-angle—*i. e.*, at the quadratures—the moon produces a high tide where the tide produced by the sun is least. The former, or spring tides, are consequently considerably higher than the latter, or neap tides. But, since the moon rises on every subsequent day 50 minutes or nearly an hour later, the lunar tide will, if it coincides on any day with the solar tide at noon, occur on the next day only at 1 P.M., while the solar tide invariably takes place at noon. Accordingly the former will, on the third day, occur at 2 P.M., and so on; so that after the lapse of a week the lunar flood will coincide with the solar ebb, while after a fortnight the occurrence of the rising tide will take place at the same time as at the beginning of this period.

Now, it might be thought that, since the small and not far-distant moon, in her position, attracts with a power that is 160 times weaker than that of the greater and more distant sun, the lunar tide would be comparatively smaller. This would indeed be the case if the whole power of attraction of these luminaries were spent in the production of the tides. But we have seen that their tide-producing power is only the difference of their influences upon the centre and the surface of the earth. With regard to the moon and its near proximity, a radius of the earth more or less is of considerably more consequence than with regard to the sun, for the latter is separated from us by a distance of 12,000 earth-diameters, the former only by one of 30, but one-thirtieth of the moon's attraction is to $\frac{1}{12000}$ of the sun's attraction as 5 : 2 (more accurately as 50 : 19); therefore, under the influence of the sun the ocean rises two feet, while under the moon's influence it rises five feet, for the difference of two small numbers may be much greater than the difference of two large ones. The average spring tides, therefore, will be to the average neap tides in the ratio of about 7 to 3—*i. e.*, of 5 + 2 to 5 — 2.

But, of what kind is the motion of water in the tides, a progressive or an undulatory one? The water of a stream flows, *i. e.*, the subsequent particles of water occupy the place which the preceding ones have left, as we see distinctly when a body floats on the water. Quite different is the case with the undulating sea. The ship does not drift forward on the crest of the wave, but merely rises and falls with it, without changing it place. If the wind blows over a grain-field, every blade yields to its pressure, to rise again afterwards. The waves advancing over the surface are therefore always formed by other blades. Just so the water alternately rises and falls successively at different places, and the succession appears to us as a lateral progress. The motion of water resembles that of the pegs inside of a piano set in motion by quickly running the hand over the keys. The wave-motion of the sea bears the same relation to a flowing stream as the propagation of sound to the wind; therefore the sea, even when in a state of most violent motion, cannot propel a water-mill, as little as by cannonading a wind-mill can be set in motion. Wave-motion and sound are both undulatory movements; the only difference, that in sound the particles of air are somewhat removed from the sound-producing body, and then return to their original place, while the water moves in a direction perpendicular to that of the wave. This up and down motion is therefore called a transverse undulation, that forward and backward motion a longitudinal one. What has been said of water refers, however, only to the short waves produced by wind, whose elevation, as compared with their transverse section, is considerable, but not to the tidal-waves, which appear very low when compared with their immense transverse section. The perpendicular motion of the former is no rectilineal one, but their predominantly vertical direction is accompanied by a small lateral one, which is manifested by the force with which a wave strikes against an obstacle in the way of its progress. This produces for the particles of water an elliptical movement, the major axis of the ellipse being almost vertical and but little inclined forward, while the minor axis lies horizontally. In tidal-waves the particles of water are also moving in ellipses, but in very elongated ones, and the major axis of these ellipses lies horizontally. The tidal-wave therefore bears a greater resemblance to the motion of the particles of air in a sound-wave, than to that of the drops in a water-wave produced by wind. The undulation of water may therefore, at the time of the rising tide, be called a progressive longitudinal undulation, since the height to which the water rises is inconsiderable as compared with the lateral motion, which appears as an ebbing and flowing current.

If the earth's surface were everywhere covered with an equally deep ocean, a very broad double wave would perform its journey around the earth from east to west within 25 hours, and such a wave would attain its highest elevation at the equator, while at the poles it would be completely flattened. This is approximately shown in the Southern ocean, where the wave is for a great distance unobstructed by land. But the phenomenon essentially changes its character in the Pacific, the Indian, and the Atlantic ocean. In each of these oceans a new tidal-wave always begins at the eastern, and is reflected from the western shore, before another primary wave has been formed. If we draw a violin-bow across the edge of a plate of glass, the bow, gliding along this elastic plate, causes indentations which progress as waves over it, and return reflected from the other edge. The more regular the intervals are in which the plate is excited to motion by the bow, the more regularly the advancing and returning waves meet, and the progressive undulations are soon converted into a stationary one, in which all parts of the plate vibrate simultaneously around their average level. If we compare the tide-producing luminaries, the moon and the sun, with the bow, and those great ocean basins with the elastic plate, it does not seem improbable that at last this broad mass of water is set into an undulatory motion, similar to that of the water in a glass which is rapidly pushed to and fro on a table. As the water in such a glass rises and falls the most at the edge, while changing its elevation least in the centre, so the ebb and flow of the tides will be stronger at the shore than at an island in mid-ocean. After having for a long time only inquired how the ebb and flow of the tides would appear on an equally deep sea surrounding the whole earth, and after having theoretically answered this inquiry, investigators have recently taken another step in advance by trying to establish by experiment and observation how the phenomenon appears on the actual ocean of the earth. This has brought to light the fact that the high tide in America indeed comes from the east, but in Africa and Europe from the west. If the tidal-wave penetrates into a narrow bay, it rises higher and higher; but on its course towards a large island it may possibly be so delayed that it arrives only when another part of the wave has commenced to ebb. As on the sounding glass-plate, amid the similar encounter of the elevations and depressions of a wave, lines of rest occur in which the vibratory motion is neutralized, so there is a place in the North sea where the waves entering through the English channel, on their meeting the great Atlantic tidal-wave on its descent along the coast of Scotland, completely neutralize the rising of the tide. The grandest accumulation of water; in connection with the motion of the tides, is found in America, in the Bay of Fundy, at the head of which the difference in the water-level sometimes amounts to 100 feet. If the tide were to rise to such a height in the Baltic, Berlin would sometimes become a sea-port, for the pavement of Dorothea street, near the old observatory, is exactly 100 feet above the water-mark in Swinemünde. But the Baltic is so cut off from the Atlantic by Denmark, that the inhabitants of Mecklenburg discovered only a few years ago that they had an ebb and flow, though of but a few inches. How grand, on the contrary, is the phenomenon on the western coast of Europe. We hardly believe our eyes when we see the children play on the dry sand at Ostend, where six hours afterwards people are bathing; or, on seeing from Bristol cliffs a dog wading through the river to the place where the omnibuses are waiting to receive the passengers who land here from the steamer; or, on finding on the railroad from Chester to Anglesia the wide bay of the Dee perfectly dry, where, on our return six hours later, we behold from the Britannia bridge proud three-masters riding; or, on taking a walk around Heligoland during low tide without wetting our feet, where, during the high tide, the surf breaks thundering against the rocks.

The descent of the Scandinavian mountains towards the sea is so steep that their lateral valleys are filled by the sea, thus forming the Fjords. Here, at the time of ebbing tide, the water flows out with so violent a rush, that it has been said, with some exaggeration, that Norway is a country where the ocean forms waterfalls. But, although they are not actual waterfalls, yet they are dangerous whirlpools, of which the maelstrom is the best known.

What is the result of this restless work? Its effect is most perceptible in the Polar sea, in the uninterrupted destruction of the ice-masses, whose formidable pressure at the time of high water even the strongest vessel is often unable to resist; but by this very fact accesses are opened into this region, which is otherwise closed by an impenetrable wall of ice. Along our coasts the effect of this work, continued through thousands of years, is likewise perceptible in the sand of the sea. If we calculate the value of labor which is required to grind down solid blocks of rock into sand, what stock company would undertake to furnish only the small quantity of sand upon which Berlin is built? The cause of this immense mechanical effect lies in the fact that waves produced by the wind are only superficial, while the tide-producing force extends over the entire mass of water. With a tidal-wave of an elevation of three feet at the equator, which were to diminish at a regular rate up to the poles, 200 (geographical) cubic miles of water would, within six hours, be carried from one quarter of the earth to the other. Although this is an insignificant quantity in comparison to the entire mass of water on the earth, which, according to Herschel, amounts to $\frac{1}{1786}$ of the mass of the earth, yet the force required for setting such a mass in motion, and carrying it through such a space, is very considerable, if we bear in mind that a cubic foot of water weighs 66 Prussian pounds. But, how high must the tides have been when the entire earth was yet in a liquid condition? We could not wonder if, in the primitive crystalline rocks everywhere the traces of violent destruction were found, even in those places where they have not been crowded into the stratified layers of other destroyed rocks at a later period only. But, necessarily, these traces will be found most distinct in the equatorial regions, because there, under the vertical influence of the luminaries upon an entirely liquid earth, the tides must have been greatest.

Whether the interior ocean, which is in a state of liquid incandescence, also forms tidal-waves, or whether it is too tenacious for such a motion, we do not know. Like the external ocean on the shore, it perhaps crowds and destroys the solid crust, along which we often distinctly perceive the progress of waves, which we call earthquakes. This crust is certainly pliable. Does not Sweden slowly rise before our eyes from the sea, which continually recedes from its shores, while along the coast of Pomerania no such change is visible? Does not the land sink down in other places, as, *e. g.*, in Istria, where Roman pavements are found under the present level of the sea? Has not Darwin even shown it to be probable that the tradition of a submerged Atlantis is realized on a large scale in the Pacific, where the great Australian coral-reef, which once no doubt touched the shore, now at a distance of many miles from it, repeats in an extent of many hundred miles, in a large arc, the contour of the coast, and where hundreds of circular coral-reefs, with lagunes in the centre, still indicate the extent of islands which were long years ago submerged, while the coral insects still industriously continue to build on the sinking foundation, to remain in contact with the surface of the sea? Their activity is only limited, and the whole structure becomes a dead mass of rock where the bottom of the sea rises and finally is laid dry, of which so distinct traces are found in the Jura mountains and their continuation, extending like a rampart from the south-west boundary of Switzerland to near Baireuth.

From the power of attraction exerted by the heavenly luminaries, we now make a transition to their heating power. As in connection with the former we disregarded the tide-producing force of the planets, being immeasurably small, so we may here leave the moon out of the question, which, to be sure, does not produce cold, as was formerly thought, but whose heat is so inconsiderable that the attempts at demonstrating its existence have only quite recently led to any result. Here, therefore, we need to take into consideration only the sun, whose heat is so great that it could melt an ice-crust surrounding the whole earth to a depth of 100 feet in one year. With every degree of heat, not only water, but even the ice at its surface, is transformed into an invisible gaseous body, aqueous vapor, which becomes again visible only when it reassumes the liquid form as mist or cloud. This evaporation increases with the expansion of surface, and is the greater the higher the temperature rises—therefore greatest in the torrid zone. Mixed with air, the aqueous vapor rising there, flows in the higher regions of the atmosphere towards the poles, and is condensed, according to the degree of cold, to rain or snow in the air, or to dew or hoar-frost on the ground. Such a process is called distillation and sublimation. As water, at its evaporation, precipitates the substances which it has dissolved, rain-water, having gone through a process of distillation, is pure. If, by artificially increasing the surface, we increase the evaporation, as is done in southern France in the evaporation of sea-water for obtaining salt, we gain a still more direct conception of this uninterrupted chemical process. The atmosphere, therefore, as is implied by its name, may be considered a great steam-apparatus, whose water-reservoir is the sea, whose furnace is the sun, and whose condenser is the higher latitudes. If the rain immediately falls back into the sea, it will again diminish the quantity of salt increased by evaporation; and old mariners report that, at a time of uninterrupted violent rains in the region of the calms, this is the case in so great a measure that drinking-water may be drawn from the surface of the sea. For this reason the quantity of salt in the sea near the equator, in the region of the calms, is less than in the district of the rainless trade-winds, and decreases again at the tropics, where the descending upper trade-wind occasions new precipitates—the so-called sub-tropic rains. If the rain, however, falls upon the land, it will penetrate into the soil, if it is porous, or immediately flow off from the higher to the lower places, if it consists of rock or waterproof clay.

Now, the surface of the earth consists to a great depth of superimposed layers lying horizontally in the plains, but sloping in mountainous regions. At the summit of mountains, therefore, the gaping edges of these layers come to light, since at the rising of the mountain the connection of the layers was disturbed, and the upheaving mass became solidified in the shape of crystalline rocks. If, now, porous and waterproof layers alternate with one another, those layers will be filled with water whenever the rain in the mountains falls upon these gaps. Our language has no appropriate word for this phenomenon, which the French call "*une nappe d' eau.*" A clear conception of the arrangement of the strata can be formed if we lay sheets of wet blotting-paper and dry writing-paper alternately upon each other, and raise the bundle to an acute angle.

If two vessels are connected at the bottom by a tube, the water poured into one of them will rise in both to the same height, however different their width and shape may be. If, at the sea-shore, a bent tube is led through a dyke, the water will, in the upper part of the tube, be on a level with the sea. If a drop of water falls into this tube, the whole ocean will rise in a proportion diminishing in the ratio of its greater surface. This law, of course, holds good for any number of vessels connected by pipes or tubes. An illustration of the application of this law is furnished by the *suterazi* of the Turks, who, when desirous of conducting water from one mountain to another, construct a stone pipe leading from the slope of the former transversely through the valley, and then again up the slope of the latter. If the Romans had known this principle, they would not have constructed their arched aqueducts, which give more brilliant evidence of their art than of their knowledge of nature.

The arrangement of aqueducts in large cities is an imitation of these *suterazi.* A main reservoir is filled to considerable height with water; the connecting pipes branch off in all directions under the pavement, and from the latter the communicating pipes, which, of course, can be filled with water only up to the level of the main reservoir, are conducted into the houses. The tendency of the water to rise is, of course, everywhere manifested in a uniform manner; consequently the upper horizontal covering of the pipe receives an upward pressure from the rising water. If it is unable to resist this pressure, the water rushes out and forms a spring. The many proofs of these phenomena which the English company gave when establishing the aqueduct in Berlin, have been furnished only to render the theory of springs more popularly known: for what else, indeed, are those *nappes d' eau* than the water in those pipes, whose walls represent the waterproof layers of the latter? Therefore, the springs gush forth at the foot of the mountains, where the upper covering broke at the time of its bending, but often, also, at a great distance from it, when the layer which is still unbroken at the foot of the mountain is discontinued in the valley, or broken at some place. If the layers lie horizontally on both sides of a so-called valley of erosion, the water issuing from them can have no power of ascending, unless the layers assume at a greater distance an inclined position. Often nature has neglected to provide an opening through which the spring is to gush forth, and must then be aided by art. In such a case the upper layer is pierced with a drill, and in such a way an artesian well is obtained.

The irrigation of the low oases in the Sahara seems to have been produced since the most ancient times by artesian wells. Shaw relates of Wad-reag, a collection of villages on the border of the Sahara: These villages have no springs. The inhabitants procure water in a singular manner. They dig wells to a depth of 100, sometimes of 200 fathoms, until they strike a stone under the sand similar to slate, under which they find the *Bahar tahr el erd*—i. e. the water. This stone can easily be pierced, and then the water gushes forth so suddenly and in such abundance that those who have gone down in search of it sometimes perish, although they are drawn up as quickly as possible. Already Olympiodorus gives a report of the digging of such deep wells in the great oasis. They are called Bahr in the erosions of the low plateau of the desert, but Schreia on the plateau itself.

When, in 1854, after the battle near Meggarin, Gen. Desvaux was encamped in the oasis Sidi Rasched, he noticed that on one side of it the palm trees had a rather sickly appearance, while in other places they looked vigorous and healthy. When inquiring about the cause of this singular phenomenon, he received the reply that it was the want of water, since one of their main wells had broken down, and they had no means of digging a new one; so they were now awaiting the day when their palm trees would cease bearing fruits, and they would have to starve, in accordance with Allah's will. The general then resolved to send to France for a boring apparatus at his own expense. An engineer of the Paris firm, Degousée, was immediately summoned, who found the matter feasible. The following winter, after four days' work by a company of Spahis, a spring yielding 4,300 litres per minute gushed from the abandoned shaft. The natives hurried on in great numbers, rushed over the blessed spring, and bathed their children in it. From all the oases petitions were now sent in for a similar favor, and about fifty wells were bored without causing any essential diminution in those previously bored. With an exaggeration that is in keeping with the tendency of the times, the hope has been even expressed that in such a manner the desert at some future time may be converted into a fertile garden.

The abundance of water in a spring may occasionally cause embarrassment. Some years ago a landed proprietor in Italy ordered an artesian well, but the spring they struck was so powerful that it submerged his estate and those of his neighbors. All efforts to close the spring again were in vain. In consequence of the law-suits instigated against him on account of the damages caused thereby, he lost his whole property. Goethe's tale of the wizard's apprentice had been realized to his misfortune. Sometimes the waterproof layer upon the summit of the mountain covers the openings of the porous ones, so that they cannot be filled with water. Thus it was near Marseilles, where the fertile soil of the vineyards was often completely washed away by violent rains. The vintagers conceived the plan of piercing the covering layer of clay by deep holes, and dug canals which conducted the water into them. Since that time springs have been formed at the sea-port of Marseilles of the diameter of a man's arm, which were previously unknown there. In 1831 the artesian well on the square before the cathedral in Tours raised branches and shells from a depth of 335 feet.

Can anyone, with the evidence furnished by these phenomena, still entertain any doubt that the water gushing forth from natural springs does not differ from the water penetrating into a mine from the upper strata, which gives so much trouble to miners, and to overcome which they dig channels above the mines to quickly lead off the water and prevent it from penetrating the latter? How many springs give out after a time of long drouth—many so frequently that they are called hunger-springs, in contrast to the spring-wells of Switzerland, which everywhere gush forth in spring-time at the first thawing of the snow! Nevertheless, here are even in our day supporters of the so called capillary theory. It is true, that in a narrow glass-tube the water rises with a concave surface higher than in a wider vessel in which the tube is placed; but this higher elevation can take place only as long as the surface is concave. If it is to flow out, the surface must first become level; and this can therefore not take place, because then the condition of the higher elevation is wanting. It may also be observed that a lump of sugar dipped into coffee will absorb it till it is filled, but no coffee-spring will gush forth from it.

But it is said that during the hot summer of 1822 the water in the mines of the Harz mountains collected to an uncommon depth, while at the surface all the springs were drying up. Is not this very simply explained by the fact that the soil, loosened by the high temperature, enlarged its natural capillary tubes to such a degree that they could no longer raise the water to the surface, and consequently the water gathered below? This explanation, to be sure, is very simple, but still clearer, no doubt, is the explanation that, as the water was pumped out by water-wheels propelled by brooks, the drying up of these brooks caused the wheels to stand still, thus stopping the pumping out of the water.

Generally, the water of the bored layers is in a state of rest, but frequently flowing; the plummet then sinks suddenly deeper down, and is set into a rocking motion, as in Paris at the Barrière de Fontainebleau, where it fell to a depth of 23 feet. At the gare St. Ouen, the third of five water-layers reached by boring, flowed so swiftly that the débris which the borer brought up from the lower layers were carried away by it; so that it was only necessary to raise them up to this layer, and not to the top of the well. How are such subterranean rivers produced? This can be distinctly seen in the Krain mountains. Here a more recent and firmer limestone is superimposed upon an older one in process of rapid disintegration. If the foundation-stone is decayed, the covering breaks down. In many hundred illustrations the depressions caused by this phenomenon can be seen on the railroad from Vienna to Trieste. If a river falls into such an opening, it disappears, and then reappears again at a great distance. When, during our travels, we inquired in the post-office nearest to the *perte du Rhône* about the way to the latter, the postmaster said: "You need not go there; in my garden you can see something far more remarkable." And, indeed, the sight that there met our eyes was surprising. We stood suddenly on the bank of a deep cut, perfectly dry river-bed, the rocky bottom of which was as porous as a sponge. If, now, the water of the subterranean river rises, it gushes through these pores and fills the whole bed. Livingstone saw even the mighty fall of the Zambesi river disappear in a deep ravine. Even in a plain something similar occurs, as with the Guadiana river, which for a time disappears under a large meadow, so that when the Spaniards are told of the great bridges in England, they proudly reply that in Estremadura there is one upon which 100,000 steers can pasture at one time. Sometimes these subterranean rivers flow only periodically, for which phenomenon we find the explanation in Greece.

Southern Europe participates in the sub-tropical rains which descend most violently in fall, and then continue through winter until spring, when they attain to a second maximum, while the summer is rainless. A portion of this water flows in Morea from the steep mountain-slopes immediately into the sea, while the rest is collected in the deep closed valleys of the interior and forms lakes. The lateral walls of these valleys are cleft in many ways, and thus form natural draining channels for the lakes, called Katavothra, when the level of the lake during the rainy season rises up to their mouth or above it. The exits of these canals are called river-heads, Kephalovrysi. In this manner the waters of the lake of Stymphalos form the Erasinas, those of the plain of Argos, near Mantinea, the Anavolo, and those of the lake Phenia the sources of the Ladou. Drama Ali, bey of Corinth, in order to prevent the closing up of the mouths, had gratings placed in three of them at Lake Phenia. At the beginning of the Greek war of independence these gratings were taken off, and thereby a rich plain was converted into a lake of 150 feet depth and 20,000 feet mean width. Similar conditions are found in connection with the Copaic lake in Bœotia, between Mounts Helicon, Chlomo, and Ptoon. In the month of August this lake is changed into a plain, with the exception of a small body of water near Topolia. Here nature has been aided by a widening of the Katavothra; and even in ancient times two artificial drains had been constructed. If these subterranean canals empty into the sea, sweet water-springs gush up from its bottom, as at Anavolo, near Artros, and on many points of the rugged coast of Argolis, Laconia, and Achaja. Such places were considered as sacred by the ancients, which accounts for the ruins of temples that are frequently found near them.

As a particular class, those springs deserve mention which originate from glaciers. They are formed by the water produced by the thaw on the surface of the glaciers, which penetrates into their crevices, where it continues to flow under the ice, until finally it often gushes forth from a splendid ice-grotto. The most beautiful illustration of these glacier-springs is found in the source of the Ganges, which, near the temple of Gangatri, breaks forth from a vertical ice-rampart as a river 120 feet wide. All these glacier-brooks, characterized by their white, soap-like water, flow more vigorously by day than by night, and the quantity of water increases with the temperature.

In consequence of the fact that the variability of temperature in the interior of the earth-crust is confined to a layer not quite 100 feet deep, springs exhibit a temperature so much the more uniform the deeper the horizontal portion of the *nappe d' eau* extends within the variable layer. In this respect a very great difference is found between springs issuing in close proximity to each other. In the watering-place of Marienberg, near Boppard—*e. g.*, according to the careful observations of Hallmann—the annual variability of the temperature of the air comprises 15° 72′; of the Michael spring, 7° 73′; of the Hassborn, 4° 77′; of the Mühlthal spring, 2° 99′; of the Hirschkopf spring, 2° 62′; of the Salzbrunn, 2° 14′; of the Louisa spring, 0° 96′; and of the most important spring which feeds the whole watering establishment, the Orgelborn, only 0° 54′. And this difference is found not only to prevail among mountain springs, but also among those of the plain.

On penetrating into the interior of the earth beyond the variable layer of its crust, the temperature is likewise found to remain unchanged through the whole year, but to rise higher and higher the greater the depth to which we penetrate. While springs at the surface of the earth have an average temperature of 8°, the water from the bore of the well at Rüdersdorf, 700 feet below the level of the Baltic, has a temperature of 18° 2′; in that at Rehme, near the Porta Westphalica, 2,144 feet deep, 18° 5′; and on boring the well of Grenelle, in Paris, the temperature at a depth of 1,683 feet was found to rise from 8½° to 22° 2′. The origin of hot springs, therefore, offers no difficulty of explanation, both as regards their temperature and its invariability. Nor is what has been stated in regard to this matter irreconcilable with the fact that, in consequence of earthquakes, springs often considerably change their temperature, for the dislocation of layers and rocks subsequent to such violent disturbances in the interior of our globe may either interrupt or open their connection with deeper layers. At the great earthquake of Lisbon in 1755, in the Bagnères de Luchon, the temperature of the Source de la Reine rose 40°, thus transforming it from a cold into a hot spring; while the opposite phenomenon, in consequence of the great earthquake of 1660, changed a hot spring at Bagnères de Bigorre into a cold one.

On its long subterranean travels the water generally meets with substances which it can dissolve. Even the ordinary spring-water is therefore chemically not as pure as rain-water; and, although the carbonate of lime which it contains in solution is found in it only in small quantities, they are nevertheless sufficient, in contact with soap, to form a flaky lime-soap, while in rain and river water the soap is uniformly dissolved. It is also sufficient to prevent the softening and swelling of boiling peas and beans, since the lime attaches to the skin and thereby prevents the access of water. On that account spring-water is called hard, in contrast to soft river-water The spring is converted into a mineral spring when it contains mineral matter in solution to a greater amount.

Regarding the formation of mineral waters, Pliny long ago pronounced the important fact: the waters are as the land through which they flow. Starting from this point of view, Struve examined the different varieties of rock in the vicinity of Bilin, Teplitz, Marienbad, Carlsbad, and Eger, and after having discovered in them all the solid constituents of the neighboring mineral springs, he attempted their artificial imitation by bringing the pulverized minerals under the pressure of a pump in contact with carbonic acid gas and water. His experiments were crowned with success, and the artificial mineral waters which he thus produced have proved to be of great benefit to suffering humanity, especially in regions at a great distance from natural mineral springs. The ocean is the mightiest mineral spring of the earth: but the uniformity of its composition, regulated by evaporation, external access of various substances and organic processes, can be fully understood and appreciated only by following the further wanderings of the water gushing forth from springs, in the form of brooks, rivers, and streams, over the surface of the earth—a theme which exceeds the limits of this discussion, and is deserving of a special investigation. It is thus the directly visible complementary link in that circular course of water, the first movements of which have so often and so long been misunderstood, because going on in the air and under the ground, and thus being hidden from the observation of man.

BRISTOL, BUCKS COUNTY, PA.

THE quiet borough of Bristol, Pa., seems to be taking a new start after a long rest in its historic career. While we note the place more for the purpose of describing its present aspects, a glance at the origin of the borough will not be without interest.

The site upon which the borough of Bristol (first called Buckingham) is erected is a part of a tract of land granted under warrant of Sir Edmund Andros, provincial governor of New York, to Samuel Clift, in March, 1681; being about the same period with the date of the proprietary charter of Charles II to the founder of Pennsylvania (March 4, 1681). After sundry transfers, deeds of partition, &c., the town plot of Bristol was staked out in 1696 into streets and building lots by Messrs. Burton, Brock, and White. The beautiful and luxuriant sections of country on each side of the Delaware everywhere offered inviting inducements to the early settlers in selecting places and rearing their intended homesteads. At the lapse of about the first fifteen years from its civil settlement, lands in the south-eastern portion of the section of country known as Buckingham (even before Philadelphia was designed and laid out) were eagerly taken up and settled upon, the patentees deriving their titles from Governor Andros. Indeed, strong expectations had been entertained that the city of Philadelphia would have been founded at Buckingham, or Bristol; but such hopes were overruled. About 1697 the "county of Buckingham" began to have the appearance of cultivated rural life, and was daily becoming more closely settled with colonists, who were chiefly members of the Society of Friends and of the English Episcopal Church.

In 1705 a court-house and prison was built in Cedar street. It was a two-story brick edifice; court-room up-stairs from an out-door entrance, and prison below; a stationary whipping-post was attached to the outer walls—the last a barbarism, it is scarcely necessary to say, long since relinquished. This building was afterwards converted into a school-house, and used as such for some years. Finally it was sold, with the lot of ground, in 1834, to William Kinsey, the then burgess of the borough.

In 1722 the chalybeate springs at Bath, in Bristol, obtained considerable celebrity, and attracted large numbers to the place, and it is stated that some parties even visited them from Europe on account of their sanitary reputation.

In 1773 stage coaches (being the first of such passenger carriages) were established by Messrs. C. Bessonett & Co., of Bristol, "to run from Philadelphia to New York in two days, for the fare of four dollars."

After the war of Independence, the citizens of the borough petitioned the State legislature for a restoration of the corporate powers enjoyed under its ancient constitution, which was granted and passed on the 16th of September, 1785. This charter continued in force, so far as it could be rendered practicable with the social and political changes, up to the year 1851, when a new chàrter was granted, which was subsequently amended in 1853.

Bristol, in common with many of the early settled towns of our country, after reaching a certain growth, ceased to advance. When we consider its many natural and acquired advantages, and its canal, railroad and river facilities, we may wonder that it has not long since realized its early promise as a town of importance. One of the most beautifully situated towns upon the Delaware, it possesses a river front of over one mile, with a depth of water rendering it navigable for vessels drawing 15 feet of water. It is but 18 miles from Philadelphia, on the line of the New Jersey division of the Pennsylvania railroad, between Philadelphia and New York, 65 miles from the latter city, and is the terminus of the Delaware division of the Lehigh canal, by which coal and iron are landed at less price than at any other point between the two great cities, being but 60 miles from the great Lehigh coal region; 36 passenger trains stop daily. The present business men of this borough are not satisfied with the "stand-still" policy which has so long impeded its progress. They have been and still are active in trying to keep pace with the spirit of the age, and within the last four years the town has made a new start in prosperity; its population has increased to over 5,000; 300 new buildings have been erected the last three years; its business has been extended, and several manufacturing establishments are now in full operation. The Messrs. C. W. & J. Peirce, of the "Livingston mills," are largely engaged in the manufacture of felt goods; their works are new and extensive—the buildings occupying over 1½ acres of ground; 160 hands are employed by this firm, and the productions of the mills are distributed in all the markets of the Union. Messrs. Hughes & Slack are also running a large mill for the manufacture of hosiery, and give employment to over 350 hands. There is also a saw and grist-mill. Messrs. Owen Jones & Co. are largely engaged in the manufacture of sheet and flue iron at their "Bristol rolling mill," and are about increasing their works. The lumber interest was once largely represented in Bristol, and the yards of E. Doron, H. M. Wright, and Dorrance Brothers, are still very extensive.

The town, as a place of residence, is very attractive. Numerous wealthy families have here made their homes. Of the handsome residences we mention those of John S. Hope, Capt. J. B. Hutchinson, James Brudon, and R. H. Morris, James M. Sclack, Morton A. Walmsley, Mahlon Kirkbride, C. W. Peirce, and those of Joshua and Joseph S. Peirce, recently erected on Jefferson Avenue.

The educational advantages are conspicuous, and consist of boarding and private schools and two public (a high and a primary) schools. A Young Men's Christian Association is establishing a library. There are lodges of Masons, Odd Fellows, Knights of Pythias, and Red Men, and also several temperance societies. Six churches of different denominations minister to the spiritual wants of the community, and the moral standard of the community is a high one.

The town is lighted with gas, and water-works are about to be erected. The fire department is a well-regulated body. Streets are 50 feet wide, but generally the new avenues now being laid out will be fully 75 feet in width. The houses are all neat and most home-like; rents are particularly low, and lots of ground 20 feet front for building residences can be bought for $160 and upwards. The taxes are light, being but $2.15 upon the $100, with property assessed but at one-fourth its value. Sites for manufacturing purposes can be obtained upon the most liberal terms, and sufficiently near the river, canal, or railroad, to enable manufacturers to entirely do away with hauling and expensive handling of either their raw materials or finished products; and the Pennsylvania Railroad Company will place sidings for the accommodation of all manufacturing establishments. The stores of the town offer a city assortment and variety of goods of all kinds. Two live newspapers are published, and aid greatly in arousing into action the enterprise of the citizens, and placing before the general public the attractions of the town. An ordinance enacted by the burgess and council, dated July 14, 1873, we cite as showing how Bristol is waking up:—

> Be it ordained and enacted by the burgess and council of the borough of Bristol, and it is hereby ordained and enacted by the authority of the same, that all manufactories which shall be erected within the borough of Bristol during the period of ten years, from and after the passage of this ordinance, shall, for and during said period, be exempted from the payment of borough tax.
>
> C. E. Scott, Burgess.
>
> Attest: J. Wesley Wright, Clerk.

By this act Bristol secures the attention of the capitalist, and invites him to examine the advantageous field still open for erecting works for all the heavier manufactures; and the opportunity thus offered we do not think will remain long neglected.

MINING AND METALLURGY.

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THE term asphalt has, of late, been used to include a great variety of substances; indeed, great confusion exists among scientists as to the precise significance of the term. Its origin and transformations are likewise matters about which considerable uncertainty exist. Dr. L. Meyn, in the course of a lengthy article on this subject in the Practical Magazine, endeavors to clear up the difficulties which surround the subject, and gives an admirable resumé of the occurrence and uses of this valuable mineral. Passing by what we may call the artificial asphalts, or mixtures of coal tar, which have no similarity with the natural mineral, we come to the author's distinction between the *bitumina* and coals. "Asphalt minerals, according to analysis and origin, are no other than oxidized petroleum or naphtha compounds. Their dispersion is hence analogous to that of petroleum; indeed, they are identical therewith, and are only distinct from this carbohydrate from their having subsequently absorbed a certain amount of nitrogen. That coal is also formed of carbon, hydrogen, and oxygen, by no means entitles it to rank in this series of bitumina; for, on the one hand, it contains, like the plants from whence it arose, a proportion of nitrogen, and, on the other, its oxygen has not been taken up in consequence of oxidation, but is only the remains of a greater mass of oxygen which existed in the organic flora, and has only partially disappeared in the form of carbonic acid and water, during the long subterranean carbonization of the vegetable mass. For the cardinal distinction between coal and the asphalts is, that the chief mass of coal is insoluble in all media, especially in ether solutions; whereas the whole mass of all asphalt matter, in so far as it does not consist of stone mixed up with it, is entirely soluble in ether solutions. The unmixed bitumina may be given in the following natural order: 1. Rock oil or naphtha. 2. Earth oil or petroleum. 3. Rock tar or malth. 4. Earth pitch or asphalt. Naphtha is manifestly the source of all the rest. It is found in small quantities in almost all, and is the first to be separated by distillation; it flows from the earth in a pure state at but few places, and the classical neighborhood of the Caspian sea is the only district to be named. It was long believed to be the product of the distillation of coal at great depth; but gradually, and especially since the discovery of the oil wells under the coal measures in America, a conviction has ensued that it is rather the distilled product of organic life, particularly animal life, spread in minute quantities in the rock, the only monument of the flesh of innumerable generations of animals. As soon as it has been in contact with air for any time it becomes greatly changed. It assumes a brown color, with a greenish tint; it grows thicker, obtains a higher specific gravity, and yields at a low boiling temperature only a slight distillate. Longer exposure to the air continues the metamorphosis, and the petroleum is changed to rock tar. Wherever petroleum exudes from the earth, and especially in places where it has been found from antiquity, rock tar is also found. Pure rock tar may be obtained from sandy masses impregnated with it, by washing or boiling with water, causing the sandy particles to subside, while the oil floats on the top. According to its density the rock tar is then either heated in open boilers for a certain time to drive out the volatile oil, or distilled in retorts, and the result is then a specially dense brilliant black pitch, superior to any other kind of pitch. Although this may be called an artifical product, from the process of evaporation to which it has been subjected, it is in fact the very substance known as viscous earth pitch or viscous asphalt. In the manufacture of asphalt this product, under the name of *goudron minéral*, forms the best basis of value, and the fused material for the liquidation of the ordinary rock asphalt in the form of mastic.

——M. J. MAUNE gives, in a paper read before the Iron and Steel Institute at the Liege meeting, a summary of recently determined facts with reference to the interesting alloy—phosphor-bronze. The Prussian government wishes to prove that a metal whose absolute and elastic resistance has been determined, can support with perfect security a definite number of tests equally determined, and inferior to the units of resistance. Consequent on this they would resolve that any portion of such material, as, for example, an axle, should only be submitted to a limited service in regard to time, partly because of the resistance of the metal employed, and also in regard to the curves it has to pass over. The result of experiments to determine these points are to be found in a work by Mr. A. Wöhler, entitled *Ueber die Festigkeitsversuche mit Eisen und Stahl.* In experiments instituted to compare the properties of phosphor and ordinary bronze, begun in April, and ended towards the middle of May, 1873, the phosphor-bronze had been subjected to 408,230 efforts of tension of 200 quintals (20 tons) per square inch, while the first bar of ordinary bronze was broken before it could be submitted to the strain, and a second only stood 4,200 of such efforts. A second bar of phosphor-bronze, loaded with 250 quintals (25 tons) per square inch, has sustained continuously 147,840 efforts without fracture. In an experiment on bending or flexure, it was found that with a maximum strain of 200 quintals a bar of phosphor-bronze broke, but only with respect to its external fibres, after 862,980 flexions, while a similar bar of ordinary bronze broke after 102,650. Lastly, a bar of phosphor-bronze, bearing a strain of 180 quintals per square inch, was submitted to 1,260,000 flexions without showing signs of deterioration.

It has been found, moreover, that the properties of phosphor-bronze differ very widely, according to the mode of its preparation and independent of its chemical composition. Bars of identically the same composition varied in absolute resistance between 75,000 and 50,000 pounds per square inch; in elastic resistance between 56,000 and 22,000; and in permanent elongation between 3.53 and 59.10 per cent. A kind of phosphor-bronze, made of materials intended especially to bear the effects of friction, has been employed for several years by railway companies, especially the Great Central, of Belgium. It has been found by Belgian and Prussian firms that, in its use for axle and similar bearings, its durability is equal to five times that of ordinary bronze. Among the uses to which phosphor-bronze has been successfully applied the following may be enumerated: Pinions and tooth-wheels, tuyeres, pump cylinders, hydraulic presses, piston packing, wire cables and ropes. Its elasticity and tenacity give it at least an equal value as a wire with any other metal susceptible of being drawn. According to Kirkaldy's experiments its absolute resistance varies between 103,000 and 151,000 pounds per square inch, and its elongation between 37.5 and 45 per cent. It may be rolled into sheets, which have besides great tenacity the advantage that they are less liable to corrosion by the action of atmospheric influences, sea-water and acids, than copper. The superiority of phosphor over ordinary bronze for ordnance has been repeatedly proved. Besides the works at Liege, there are now works for the preparation of this alloy in Germany, England, and in the United States.

——THE Büttgenbach blast-furnace construction is, at present, the subject of animated discussion. The first furnace was built by Büttgenbach, on his system, in 1865, at the Neuss smelting works, Prussia. Since that time 17 furnaces have been built in Germany and France, and have worked successfully. The subject has recently been brought prominently before the metallurgical world by the Vienna exposition, where a model of the furnace was exhibited, and by a paper read by Büttgenbach before the Iron and Steel Institute at Liege. The peculiarity of construction of the Büttgenbach furnace, which may be regarded in the light of a violent reaction from the old style of heavy masonry furnaces, may be briefly summed up as follows: The mason work is quite independent of the blast-furnace proper. Each ring or course of bricks constituting the hearth boshes and inside wall is readily accessible and free from any casing, except a small portion, 3 to 4 feet in height at the widest section of the furnace. The pillars supporting the platform of the furnace top are gas pipes, and serve to conduct the gases from the mouth of the furnace down into sheet iron vessels fixed to the summit of the base of the stack. These vessels are open on one side, and are filled with water to a certain height to prevent escape of gases. Here the dust is deposited and the watery vapor condensed. Among the advantages claimed for this system of blast-furnace construction are simplicity and cheapness, and a ready accessibility of parts, and these claims are not disputed. It is further claimed, however, that these furnaces work more regularly, permit of longer campaigns, and use less coal per ton of pig iron than furnaces of the ordinary construction working under similar conditions. On the one hand, M. Büttgenbach refers to the record of seventeen furnances built on his system in support of it, while his opponents rely mainly on *à priori* reasoning to refute his claims. The main point of difference in the argument is the amount of fuel used; in other words, whether thin wall furnaces are more economical than furnaces with thick walls. At first thought one would naturally decide in favor of thick walls, as they unquestionably must retain more heat. This M. Büttgenbach does not deny, but affirms that this cooling in the upper part of the shaft is an advantage within certain limits, as it prevents sintering of the charge, allows of more perfect reduction, and the charges sink to the melting zone regularly, fully prepared for fusion. It is to be hoped that M. Büttgenbach's system will be tried in England and in this country.

——ONE of the most important and suggestive papers read at the Liege meeting was a brief one by M. Charles Boutmy on the combustion of gases. The author holds that the complete combustion of a gaseous mixture can be brought about only on condition of the mixture being raised to and kept at the temperature requisite for the combustion of the gases. The process of combustion, even though commenced, is arrested by chilling the ignited mixture to the requisite degree. Gases issuing from chimneys, when subjected to analysis, have disclosed the fact that even at a temperature of 400° C., they still contain a notable quantity of combustible gases mixed with a proportion of atmospheric air several times sufficient to admit of their burning. We are entitled, therefore, to conclude that a temperature of 400° C. is insufficient to allow the combination of carbonic oxide and carburetted hydrogen with atmospheric air; and that boilers, the temperature of which rarely exceeds 155° C., produce upon ignited gases passing beneath them the same effect as does wire gauze upon flame; and, as a result, we have a large part of the gaseous mixture passing off uncombined. To obviate this waste the author insists on the necessity of burning the gases in a special chamber of fire-brick, the walls of which will become so intensely heated as to insure the complete combustion of the gases entering into it. This idea of a special chamber of combustion is not at all new. All of the modern hot-blast stoves are provided with them; yet the idea which led to their adoption was rather to secure equable distribution of heat and prevent the destruction of the pipes, than to effect complete combustion. It would certainly be a great gain in the economical use of blast-furnace and other combustible gases were the system to be extended to boiler heating.

——STREAM tin has been found abundantly in Australia since 1870, but it is only recently that tin lodes have been regularly worked. The Australian tin mining company, in the New England district of New South Wales, exhibited a mass of oxide of tin weighing 130 pounds at a recent meeting of mechanical engineers at Penzance. Two lodes are known to penetrate the property of the company, each of which is more than a mile long, and yields ore assaying from 50 to 70 per cent. of tin. There are also more than three miles of stream fed by these lodes, which are so rich that as much as 19 pounds of block tin has been taken from six tin mining pans of earth—a contrast to the 1½ to 2 per cent. yields of the Cornwall and Devon mines. The country rock is granite of coarse grain, containing large crystals of feldspar.

——IT is stated that Messrs. John Brown & Co. of the Atlas steel and iron works, Sheffield, have been successful in experiments made for the purpose of testing whether spiegeleisen could be produced in their own blast furnace from the Spanish ore. This ore is imported by the firm direct from the mines at Bilboa, owned jointly by them and Messrs. Bolckow, Vaughan & Co., Middlesbrough. It is understood that the product possesses all the physical characteristics of the best iron from the Siegen districts, containing, in one case, 4.41 per cent. of carbon and 13.17 of manganese, and in another, 4.62 carbon and 12.89 manganese.

——An incidental result in the practical working of Danks's rotary puddler, namely, the reduction of the iron of the fettling, causing an increased yield of iron over the pig charged, has awakened new interest in the subject of the direct production of iron and steel. One of the latest devices to imitate this action of the Danks puddler is that of Messrs. Rochussen & Daelen, who endeavor to combine the Bessemer process with an ore reduction process. They propose to line the lower half of the Bessemer converter with a fettling of iron ore. This ore lining does not replace entirely the refractory lining, but covers it, as well as a part of the tuyeres. They affirm that there is sufficient heat developed during the process to effect the reduction of this ore and still retain the steel in a fluid state. They likewise expect that the carbonic oxide formed at the bottom of the converter will be burned in the bath to carbonic acid by the blast, and an additional source of heat obtained. During the early stage of the process, while the reduction of the fettling is going on, there is supposed to be but little blast needed; but, when all the ore is melted, then the remaining tuyeres are exposed and a full quantum of air supplied. The objections to this scheme are so numerous and evident that it seems scarcely worth while to enumerate them. It is, however, asserted that several converters have been erected on this principle and worked with satisfactory results. On this latter point we must be allowed to be skeptical. The renewal of the lining after every blow must be a serious item of expense. Only the very purest ones would be applicable, and the loss of heat consequent on the decomposition of a large amount of oxide of iron would be so great that only the very "hottest" pig irons could be worked successfully. The heat supposed to be gained by the combustion of carbonic oxide within the bath is purely imaginary, as carbonic acid could not exist in contact with molten iron, to say nothing of the carbon and silicon. The Bessemer process will gain nothing by this attempt to make a Danks attachment.

——The injurious effects of the Idria smelting vapors have been the subject of an interesting series of articles in the *Kärnthner Zeitschrift*, by Hugo Ritter von Perger. The inhabitants in the vicinity of the works have for almost a century made repeated complaints of the injurious influence of the mercurial vapors, but the authorities have persistently ignored them. These vapors are said not only to be noxious to man, but to cause a great mortality among the domestic animals. Perger calculates that in the old Leopoldi furnace, having condensation chambers of masonry, with a loss of 25 to 33 per cent. of mercury, there was a yearly loss of 1,250 cwt. of mercury. Supposing 5 per cent. of this was lost in the form of vapor, there would be communicated to the air yearly 62.5 cwt., or 349,709 litres of mercurial vapor, besides 241,461 litres of sulphurous acid, or, daily, 958 litres of mercurial vapor and 660 litres sulphurous acid. On breaking open a condensation chamber of a Leopoldi furnace, the bricks were found to be thoroughly impregnated with mercury. In the Alberti furnace, at present most used, having iron pipes for condensation, the loss is as great as in the preceding, while the newer muffle furnaces give much better results. When the finely pulverized ore is mixed with lime, formed into bricks, and heated in an iron muffle, there can be no loss of metal by transmission through the walls, and the sulphurous acid remains combined with the lime. But on opening a muffle after burning, the workmen are exposed to the vapors, and if we attempt to prevent this by drawing air through the muffle, mercury is lost again, which latter loss might, however, be avoided by more complete condensation, longer canals, and high chimneys. Among the most important improvements suggested to remedy the existing state of affairs are: Replacing the Alberti by muffle furnaces with the most complete condensers possible, conduction of the vapors to one main high chimney, providing respirators for the workmen, and, finally, the appointment of a commission of experts to inspect and test the efficiency of these precautions.

——Dr. Hofmann communicated to a recent meeting of German engineers a method for desulphurizing coke. It consists in extinguishing the coke as it comes from the ovens with water containing chloride of manganese in solution. The sulphur passes off as sulphuretted hydrogen, while manganese and the excess of chloride of manganese remain, forming an advantageous addition to the coke for iron smelting. Chloride of manganese is a waste product, in many factories of bleaching salts. It is understood that the process will be tried on a large scale.

——THE first number of the Journal of the Iron and Steel Institute, for 1873, has made its appearance, containing the account of the meeting of the institute held in London, in April, 1873. Most of its contents have already appeared in the current technical literature. A communication from Mr. Frederick F. Jones on his method of iron reduction is, however, new. This method consists in melting iron ores in a cupola furnace, and forcing through the melted ore, as it descends, a hot current of carbonic oxide. This carbonic oxide is generated in another cupola, fed with coke alone, and is, of course, mixed with its corresponding amount of nitrogen. It is difficult to see why the same results might not be obtained from one cupola—the one in which the ore is melted—by the employment of an additional amount of coke. The apparatus may be said to be a low blast furnace in which the ores are introduced at once into a zone hot enough to melt them. A more rapid production may be obtained in this way, but there certainly can be no economy in it. Only one analysis is given of the product thus obtained, that of an iron made from tap cinder. It contained:—

Iron	96.750	Manganese	trace.
Combined carbon	0.330	Silicon	"
Graphitic "	0.190	Sulphur	0.031
		Phosphorus	2.736

The small amounts of carbon and silicon in the iron are due to its rapid production and to the relatively low temperature. The excessive amount of phosphorus is, of course, due to the material—tap cinder. Here is a good chance to try dephosphorizing panaceas! No analysis is given of the cinder formed—an item of great interest. The inventor promises soon to give more definite information about the process.

——NEW JERSEY spiegeleisen, often unfortunately called Franklinite, has been for some time produced from the residue of zinc ores after the ore has been treated for the extraction of the zinc; or, rather, for the conversion of the zinc into oxide. This residuum contains, besides 6 per cent. of zinc, about 18 per cent. of manganese and 40 per cent. peroxide of iron, and is, as might be expected, an excellent material for the production of spiegeleisen. It has recently been discovered, by a clever Jerseyman, that if we add to this residuum any ore of iron, as hematite or magnetite, the yield of spiegeleisen is increased. The addition of a rich ore of iron could scarcely be expected to have any other effect than increasing the yield, and if the relative amount of manganese in the charge is not too greatly diminished by this addition, the product must still be spiegel. Strange to say, a patent has been granted for this wonderful discovery.

——MR. GEO. W. BILLINGS, of Chicago, has patented a process for annealing plates of steel preparatory for punching. It consists simply in exposing the parts to be punched to a jet of steam at a temperature of 300° F., more or less.——MR. WM. DOUGHERTY proposes to cast steel in moulds of thin sheet metal so as to effect a complete welding between the two. The exclusion of air from the steel when subsequently heated is said to obviate the bad working which might result from a honey-combed structure.——IT is only comparatively recent that the subject of economic coking of coal has received attention in this country. The advanced position of Belgium in this respect can be well studied in an instructive paper on coke ovens by M. Augustus Gillon, professor at the School of Mines at Liege, read at the recent institute meeting at Liege.——THERE are at present in Europe 165 Bessemer converters, with a yearly production of 700,000 tons, and 55 to 60 Siemens-Martin furnaces, with a production of 55,000 to 60,000 tons of steel.——MR. J. SWAIN, of Oldham, England, has patented a form of melting cupola furnace, the peculiarity of which consists in a receiver, or sort of fore-hearth, where the iron collects as fast as it flows from the cupola. While in this receiver it may be exposed to a blast of air, whereby it becomes more or less refined. Comparative analysis of the pig iron melted and the refined metal show for the latter a decided diminution of silicon, which might be expected, and also a diminution in amount of phosphorus, which could not have been anticipated, and can hardly be credited.——A NEW form of puddling furnace has recently been brought into prominent notice in England. It is the invention of Mr. Bayliss, of Workington. It consists of three parts—a melting, a refining, and a puddling or balling chamber. The inventor claims for his furnace economy of working, increased yield, and superiority of product. He, moreover, affirms that the rotary principle is not the right principle when applied to furnaces—as Danks's—but when applied to a tool—Bayliss's tool—rotation is quite the hing.

INSURANCE.

WHOEVER has watched the shiftings of professional actuaries in connection with American life insurance, and especially of some who get their names oftenest in the public prints, must have been infinitely amused—when not disgusted. There is much in the performances to recall to the intelligent observer the achievements of geologists in the time of the oil fever, when the petroleum indications deduced from the topography and stratification of the land were, as a rule, in happy accord with the owner's estimate of its commercial value.

The life reserve, by the present measurement, shows, as a whole, signs of precariousness; but from any unpleasant contemplation of such a fact we are happy to be relieved by the new indications—by the discovery that the rule of measuring is vague and capricious, and its exactions altogether unnecessary. Once, that is when there was an ample surplus over the requirements, the net premium reserve was the preëminent glory of American life insurance—no plaudit in its praise could be too vehement: now, there is a falling away from allegiance to that standard, and the conclusion of the matter is like the sudden fall in the swelling crescendo of the Mohammedan vender: "In the name of the Prophet—figs."

As part of the proceedings of the fourth annual session of the National insurance convention, there appears a paper relating "to the proper treatment of a life insurance company which should be found not to possess the reserve required by the State standard." This paper is by Mr. E. W. Bryant, now actuary of the Life Association of America, and who was actuary of the New York insurance department under the Miller régime. As the simple personal utterance of Mr. Bryant, the views which he advances would pass unchallenged by us; but as his deliverance was made at the request of the National convention, which we must regard as a representative insurance body, we take occasion to make a few notes thereon.

We extract from Bryant:—

> 1. Contracts of insurance upon life are undertaken upon the assumption that given rates of mortality, interest and expense, will be realized as *average* results over considerable periods of time. The present system of State valuation is founded on the assumption that given rates of mortality, etc., will be realized, not only in the long run, but that they will hold good for each year taken by itself; that is, that the income from premiums and interest for each year, considered by itself, will pay the expenses, losses, and the year's addition to the reserve.

Now, what is called "State valuation" is in no sense an origination of State legislation, but the adoption by the State of a device in computation, as old in its essential elements as the doctrine of life annuities; but the assertion that it rests upon the assumption that given rates of mortality and interest "will hold good" (be realized) "for each year taken by itself," is not quite so ancient, and is not likely to outlast the freshness of its novelty. The meaning of this is, that a valuation of policies—say by American Experience, 4½ per cent. basis—proceeds upon the principle that there will be exactly and certainly 4½ per cent. interest realized every year on the premium investment, and policyholders will die exactly, each year, 1.116 per cent. at age 45, and also at other ages depart most strictly in accordance with the settled order of their going. Now, as this is a prediction of an order of occurrences which *never* can be, excepting as a marvellous coincidence, where is the idiot to be found who is to assume it *will* be? and should there be a failure to produce such a party, the assumption falls for want of an assumer. The inherent law of State valuation discounts the future and aggregates the geometric increments of all the past; therefore, it necessarily, inevitably, unavoidably grasps the whole career of a policy, not a single year, and is just as good for a five-year computation as for an annual one.

> 2. If a company is found not to have the required reserve, it is said to be "insolvent," is to be enjoined from the issue of new policies; and some say, should be at once dissolved, and its assets should be apportioned among those to whom they belong—and this, too, whether the degree of "insolvency" be one, or ten, or fifty per cent. of the reserve. Plainly there is something wrong in this; for a company having $5,000,000, earning six per cent., could in one year make good from surplus interest a deficiency of $100,000 in a four per cent. reserve. Such a chance of recovery ought not to be refused; and, in general, a company which is constructively insolvent should be allowed to make the endeavor to replenish its reserve.

The matter of leniency or concession to a company weakened below the standard is a very different question from that of a proper reserve. While opportunity of recovery should be accorded to a company that deserves it, it does not warrant any diminishing of the standard figures in order to obliterate such company's deficiency. To make the company aim to attain to an established reserve, is beneficial to it; to drag the reserve down to the level of the impaired condition of the company, does it no good, and the general interest much harm. The exemplification of the "$5,000,000" assets "earning 6 per cent.," refutes itself. That a company earning 6 per cent. has not been able to secure 4 per cent. interest, is, *per se*, something more than a paradox to those who cannot conceive why more brings less; and if the surplus in 6 per cent. interest actually received has been overcome by excess in expenses and mortality, it is plain that the interest excess goes for nothing as an instrumentality for recuperation.

> 3. [in continuation of No. 2.] Unless there are good reasons for believing that the causes which have produced the present deficit are such that it is not likely to be made good, or that it will probably increase. If the premiums are so low, or the unavoidable expense will be so great, or if the lives insured are so unsound, or reside in so insalubrious regions, that recuperation may be despaired of, there is nothing to do but decree the dissolution.

Rather so. But we will not spoil the Bunsbyism of this excerpt by any comment.

> 4. But a net valuation made by the usual processes is not a conclusive test of a company's solvency, and does not infallibly prove, in case of a deficiency, that the company cannot carry forward its policies to maturity and pay them all.

This is of the current "talky, talky." It is a mere play upon words to say net valuation *is* or is *not* a test of a company's solvency. Such valuation simply marks the stages of a defined process of accumulation. The net premium in the calculation assumes the minimum of prophecy as to the future business, and while there can be no mathematical expression of absolute life insurance solvency, the net valuation escapes a good amount of contingency; and if it does not prove much as to the ability of a company "to carry forward its policies," it does show, "in case of a deficiency," that a company *must come up* before it can go *forward*, financially.

> 5. In such a case an estimate, or rather a *valuation*, should be made of the company's resources for recuperation, which will be—1st, the rate of interest realizable in excess of the table rate; 2d, the saving that may be made from the margin over expenses. If six per cent. interest be counted on, and expenses will not exceed twenty per cent. of the premiums payable, the valuation will be made by reserving not less than the difference between the net six per cent. single premium for the sum insured, and the six per cent. net present value of four-fifths of the future premiums; which reserve must also be made less than the six per cent. net single premium for so much paid-up insurance, if any, as may now be claimed under the policy. This may be best illustrated by so valuing a policy for $1,000, issued, say three years ago, at the age of 40, payable at 60, or on prior death, by twenty annual premiums of $52 each. Disregarding fractions of a dollar, the four per cent. actuaries' reserve on such a policy, at the end of its third year, is $100. The six per cent. net present value of the insurance is $428, and the same value of four-fifths of the future premiums is $421, from which it appears that seven dollars is the six per cent. reserve by this process; but the alternative rule must be observed that the paid-up insurance value of the policy being three-twentieths, $150, must be protected by at least the net single six per cent. premium therefor, which is $64 against $84, which would be required at four per cent. if the policy became paid up for $150. In this case the whole (possibly) available recuperative power has a present value of $93, the difference between the extreme reserves, highest and lowest; but if the policy becomes paid up, the

> replenishment can come only from surplus interest on the actual present reserve, or, in other words, $64 will, with six per cent. interest, pay the $150 when due.

As the wraith in old legends forerun the death of a member of the household, so the 6 per cent. spectre haunts the avenue of impending bankruptcy. Mr. Bryant's net valuation, as against other peoples' net valuation, amounts in the main to a 6 per cent. calculation of a business conducted upon a 4 or 4½ per cent. basis; and if such an exigency as to present results can be claimed to have come, it is the severest condemnation yet passed upon American life insurance. In a proposition submitted at a previous session of the convention, in advocacy of a *maximum* State valuation rate of interest, Mr. Bryant gave it, as his opinion, that "the rate of interest to assume in State valuations of each company should be the rate adopted by the company in the computations of its premiums." Now, the recuperation valuation, while it sets aside the doctrine of this proposition, extends its practice as a 6 per cent. dodge. The illustration given tells its own story. There is a scientific jump in the reserve when the imminence of paid-up insurance runs against a short provision, and a difference of $93 in *calculation* is $93 in *cash* going out to recuperate. Had the conjectural resources of this recuperation theory been enumerated a few years earlier, a No. 3 would possibly have been added, viz., excess of tabulated mortality over mortality experience.

> 6. It has been proposed that a company be given a "leeway" or oscillation of ten per cent. of its reserve, without other penalty than that of refraining from the issue of new policies. This seems to me wholly inadmissible, unless its policies were generally "commuted" or converted into "paid-ups." The older a given policy is, the greater is its reserve, and the larger would be the "oscillation;" but the older the policy, the fewer will be the years of its possible future duration, and, therefore, the smaller its recuperative power.

Mr. Barnes's benevolence to distressed companies was a simple margin of grace introduced under a foolish title. At its worst, it would not mislead as to the actual position of a company. It is not in our recollection that Mr. Barnes would put an embargo on the new business of a company which, with 90@100 per cent. of its reserve unimpaired, he would allow opportunity to repair deficiency; but, possibly, his critic may be right in this respect. But, to say that the "oscillation" is greater as the reserve on a given policy increases, is to say that $60 is a greater percentage of $400 than it is of $200. The maximum of the margin is 10 per cent. of the net value of every existing policy. The result to be determined by the business as a whole, not by the fate of certain single policies having "recuperative power within rather narrow limits"—a besetting affliction of more than one recuperative project.

> 7. From what has been said, the transition is natural to the subject of net valuations in general, but I forbear to enter upon it further than to say that the mode of valuation pursued by nearly all the State insurance departments is well known to be incomplete, arbitrary, and not in accord with either fact or reason; and in many cases it directly misleads as to the nature and extent of the security which it professes to determine, and which it exhibits as conclusively ascertained. By a remarkable perversion, the exising system of net valuations has, in certain cases, the same effect that follows from the much and deservedly condemned system of gross valuation, when a gross premium is valued as a net premium as against the value of the amount originally insured. The theory of net valuations by a standard rate of interest should either be abandoned, or else it should be correctly applied; and when so applied, the resulting reserve will always stand the two decisive tests: 1st, it will be not less than the accumulated past net premiums, at tabular interest, less tabular charges for the risk carried; and 2d, it will also be not less than the difference between the net present value of the insurance, by the standard rate of interest, and the present value by the same rate of interest of the actual net future premiums receivable.

We are not inclined to deny that there is a colored individual in the valuation woodpile. But the "existing system of net valuations" was once deemed the acmé of American actuarial wisdom, in exalted contrast for trustworthiness and honesty with the gross valuation of the British school, and about as sure in process as Newton's formula in the involution of powers. It is refreshing to hear now that the "mode of valuation pursued by nearly all the State insurance departments" is a botch, without the support of "fact or reason." As comparisons are "odorous," it would doubtless be invidious to name the exceptions to the "nearly all" which are figuring in the dark; and it is certainly a pity that the mathematical work of the New York insurance department, in a certain era in its history, did not illuminate the pervading darkness. When a "perversion" of net process figures up to the gross in its value of future resources, there will be no necessity for doctoring the reserve by striking between the two premium factors, in the way of recuperation, with a net-earned premium, *yet to be earned.* The ringing of changes upon present rules does not promise any very radical reformation, and so long as current practices are in the position to be charged with the reverse of depreciating the estimate of aggregate matured liability, we escape treading upon more dangerous ground; and, forced to possess our souls in patience until we attain to better knowledge, we can afford to act in the interim upon the simple admonition: Guard the life reserve!

——THE fourth annual Wisconsin life insurance report shows 26,377 policies in force December 31, 1872, issued upon lives of citizens of the State, insuring $42,233,477. Of this aggregate the North-Western Mutual, the only Wisconsin company, had 10,296 policies, $13,930,054 insurance. The other-State companies, therefore, 16,081 policies; insurance, $28,303,423; total State business of the year, 6,478 policies; insurance, 11,423,411—of which the North-western issued 932 policies, insuring $1,376,731. The following are the premium receipts and loss payments in the State for the last four years respectively, with ratio of loss to premium:—

Year.	*No. of Companies.*	*Prems. received.*	*Losses paid.*	*Percentage.*
1869	43	$1,780,275	$310,089	17.42
1870	36	1,770,050	268,755	15.18
1871	39	1,834,838	315,337	17.18
1872	37	1,669,252	349,557	20.94

There are doing business in this State, and also included in the list of life companies (according to an erroneous custom) the two Illinois coöperatives—the National Life and the Protective Life of Chicago. Concerning these, ex-officio Commissioner Breeze remarks: An official examination of the assets having been made by the superintendent of insurance of a neighboring State, and the annual statements having been duly authenticated, it is assumed that the assets are good, and that the policy liabilities are correctly computed, according to the standard and the exact conditions of the insurance contracts or policies.

The ratio of net reserve to amount at risk in the National Life on December 31, 1872, was 1.11 per cent.; in the Protection Life, .97 per cent.; the average ratio in the ordinary life companies was 13.32 per cent.

One peculiarity of this class of companies is that the longer a policy runs, the less its value or liability; while the reverse is true of a policy in an ordinary life company.

A supplemental statement of the National shows that the policyholders are divided into six classes; that out of $2,500, the face of the policies, $1,000 is guaranteed to every one of the insured in divisions B, C, and D, and that out of $10,000 in the class called the "Commercial League," $4,000 is guaranteed.

Since the admission of this company into Wisconsin, ten of its members, who were residents of this State, have died. The aggregate insurance taken by them was $30,000; guaranteed by the company, $12,000; paid $14,609, or 48.70 per cent. of the insurance. Had the classes been full, and all the members paid their dues and assessments, the representatives of these deceased members would have received $30,000, the whole amount of insurance, as represented by the policies; as it was, less than one-half of that amount was realized.

Supplemental statement of the Protection sets forth that there are no "classes" in this company; all the policyholders are together and contrrbute to the payment of each loss.

The company issues policies for only two amounts, viz.: $2,500 and $5,000, conditioned on the number of members in the company; but each policy contains a guarantee of at least $1,000 for three years and five years respectively. All the policyholders contribute to the payment of every loss, each paying his proportion according to age and the amount of his policy.

After the expiration of the "guarantee period," the value of the policy, or liability of the company to pay any definite sum ceases; the company agreeing to pay only what it receives from the assessment, together with the amount of the "defaulted assessments" upon policies then in force.

Failure to pay monthly assessments and costs of collection within thirty days after date of notice, renders the policy void.

The statement of the Protection shows that only one of its members residing in this State has died since its admission, and that the policy of that one had lapsed for non-payment of premiums and assessments.

The amount of insurance in force, December 31, 1871, of the National, $6,672,000; lapsed during the year 1872, $5,658,000 ($9,000 surrendered), or 84.80 per cent.

Amount in force, at the same date, of the Protection, $1,593,000; lapsed during the year, $1,453,000, or 91.21 per cent.

Average ratio of lapsed and surrendered policies to risks in force in all the life companies, including these two, 11.89 per cent.

As nearly all of those who were members in these two companies at the beginning of the year went out, or suffered their policies to lapse before its close, and as the security of the companies and the amount of insurance which a beneficiary will realize at death depend largely upon the number of paying members in the class, or in the company, it is manifest, to say the least, that it is a *very uncertain resource* for dependent widows and orphan children.

——As the decision of the Kentucky court of appeals, in a matter of issue of State-unauthorized insurance contracts, has been variously represented, we give in full the circular relating to the same, published by the State auditor. The higher court sustains the court below in adjudging that such contracts, being made in violation of law, cannot be enforced.

OFFICE, AUDITOR PUBLIC ACCOUNTS,
FRANKFORT, September 27th, 1873.

The appended decision of the court of appeals, delivered by Chief Justice M. R. Hardin, is published for the information and instruction of those interested in the matter of insurance, whether fire, life, or accident. Its great importance makes it a matter of vital interest to policyholders as well as to insurance agents. Very respectfully,

D. HOWARD SMITH, Auditor of Kentucky.

STATE OF KENTUCKY,
COURT OF APPEALS, September 3d, 1873.

FRANKLIN INSURANCE COMPANY, &c., Appellants,
vs.
LOUISIVILLE & ARKANSAS PACKET CO., Appellee.
} Appeal from Louisville Chancery Court.

The court being sufficiently advised, delivered the following opinion herein, to wit: The appellants, four insurance companies, located and incorporated by law in the State of West Virginia, instituted this suit in equity in September, 1871, against the Louisville and Arkansas Packet Company, upon several contracts of the defendant for the insurance of its steamboats plying between the city of Louisville, Kentucky, and certain points in the State of Arkansas—the claims amounting in the aggregate to $2,430, for which, and the probable costs of the suit, an order of attachment was sued out and levied on the defendant's boats, Glasgow, R. C. Gray, and Pink Varble.

Afterwards the plaintiffs filed an amended petition, making John B. Castleman a defendant, to whom, as they alleged, the packet company had made an assignment of its property and effects, and seeking to enforce, as against him, as assignee, their claims and lien under the attachment. Castleman defended the action, not only controverting the alleged grounds of the attachment, but also the validity of all of the contracts of insurance as having been made by the plaintiffs, in the State of Kentucky, by T. B. Wayley, their agent, in violation of the law of this State, they being only incorporated by the laws of another State, and having wholly failed to comply with the conditions prescribed by the law of this State, upon which alone they could, through their agent, have lawfully transacted within it any business of insurance. There is some contrariety of evidence as to the capacity in which Wayley acted in effecting the contracts of insurance; but whether his attitude was that of an employed and accredited agent of the plaintiffs, or a mere insurance broker, it is clear, from the evidence, that he delivered the policies and took the notes of the defendant for the plaintiffs at Louisville, Kentucky, and thus, on their behalf, consummated the contracts, and did so without complying with our laws in regard to foreign insurance companies, and for that service he was adequately compensated by the plaintiffs. Upon the facts thus appearing, the court below adjudged very properly, as we think, that the contracts were in violation of law, and could not be enforced in the courts of this State.

We cannot think that any argument is necessary in this case in support of the power of the legislature to prescribe and regulate by law, as was done by the act approved March 12, 1870, (1st volume acts 1869–70,) the terms and conditions on which fire, marine, and other insurance companies not located or incorporated in this State should be allowed to conduct the important business of insurance within it; and it seems to us that that act, by its tenor, details, and manifest objects, clearly imports a legislative purpose and intention, not only to prevent certain violations of the act by the imposition of penalties, but to render it absolutely unlawful for foreign insurance corporations by their agents, as in this case, to make contracts of insurance within the State without complying with, and in disregard of the provisions of the act. This is particularly manifest from the 24th section of the statute, declaring it unlawful for such corporations to do insurance business in the State without an actual paid-up capital of $150,000, and by the 25th section, rendering the transaction of insurance business in the State by the agents of foreign companies unlawful, if done without the obtaining of a license from the auditor of public accounts.

Construing the statute, as we do, as not intended merely as a means of raising revenue from the business of insurance, but to affect the validity of contracts of insurance made in violation of it, or, in other words, to prohibit the business itself, so far as carried on in violation of law, the contracts of insurance sought to be enforced in this case were clearly illegal, and, upon principles of law now well settled, the court below properly refused to enforce them.—(*Lindsey* vs. *Rutherford*, 17 *B. Monroe*, 245; *Chitty on Contracts*, 419.)

Wherefore, the judgment is affirmed.

——Part II, of eighteenth annual report of Massachusetts insurance commissioner, embraces the business and financial exhibit of 48 life companies, against 56 embraced in the previous report. As usual there is no showing of the distinctive State business. The 6 Massachusetts companies (including the Massachusetts Hospital, which had 10 policies in force) disclose no gain in business by the operation of 1872, the terminated policies being about equal to the new ones, viz.:—

	Policies.	*Insurance.*
New business, 1872	9,276	$21,475,189
Terminated, 1872	9,054	21,821,984

A business thus resulting was conducted at a gross cost of $1,067,660 out of $6,818,233 receipts. Ratio of expenses to receipts in the last two years as follows: 1871, 14.74 per cent.; 1872, 15.66 per cent. Ratio of assets to liabilities, 1871, 115.20 per cent.; 1872, 113.74 per cent. We extract as follows from the report:—

ANNUAL STATEMENTS.

The most necessary information which companies furnish the world is contained in their annual statements. It is, therefore, of the utmost importance that these should be accurate, trustworthy, and correctly understood. If public confidence in them is shaken, the interests of life insurance will be much impaired. Even if accurate in a certain sense, they may be made up in such a way that, without explanation, the public will be entirely misled.

We propose to show in a subsequent connection why it is necessary to allow credit for quarterly and semi-annual instalments, of which payment is deferred. As a company is charged with liability on account of its policies, as soon as they are issued, a corresponding credit must be given out of the premiums to which it becomes entitled. But even when the whole amount of the annual premiums is due and payable at the beginning of the policy year, they are not by any means always received at the home office as soon as the policies are issued. The companies, however, immediately claim a credit for these premiums as being in course of collection. Perhaps, under the circumstances, this method of keeping the accounts cannot be avoided; but the result is, that credits to large amounts are taken for moneys which are never actually received. Many policies, although issued from the home office, are not in fact accepted by the applicants, and they are returned by the agent. It is true that after they have been returned and liability on account of them ceases, credit is no longer claimed for the unpaid premiums, but in the meantime the apparent volume of premium receipts has been swollen beyond its real amount.

We might enumerate other classes of entries which stand in equal need of explanation. For example: sometimes the value of a surrendered policy is not paid in money, but a paid-up policy is issued instead. In such cases, the surrender values are frequently entered among premium receipts as though received in cash, as single premiums for the new policies. So, also, dividends are credited among premium receipts when paid-up policies are accepted in their place. Unless credits of this character are understood, the estimate made from its annual statement in regard to the amount of a company's receipts would be erroneous.

Fictions of this kind are entirely admissible so long as they are subservient to the purposes of equity; but they are liable to abuse. If a company's accounts do not naturally fulfil the conditions of the statute, the temptation is strong to force them for that purpose. *These entries furnish a convenient means; for a company, if so disposed, may use them to meet almost any required conditions, unless forestalled by official intervention.*

But other evils exist in the rendering of annual statements. Among the most troublesome are the great delays which are beginning to occur in their preparation and transmission. One of the chief causes assigned for delay is the large amount of premiums in course of collection, and for the purpose of reducing the amount, *on paper*, some companies purposely keep their books open till the first of February, and even later, in order to reduce that item by transfer of actual receipts to some other. Such usage is unnecessary, and ought to be discarded. The plea that any other system is "not practicable," is entitled to just as much consideration as the plea that a balance-sheet showing *actual* instead of *apparent* assets is "not practicable," when in fact it is entirely practicable, as the annual statements of many companies have attested.

It is a curious fact, in this connection, that some companies transacting the smallest amount of business frequently require a much longer time to make up their returns than others whose business is vastly greater, the former being occasionally unable to render their statements under two and a half or three months. Most of the companies, we are happy to say, are commendably prompt in this matter, and if all would emulate the example of the United States Life, of New York, both their own and the business at large would derive material benefit.

COMPARISON OF ASSETS AND LIABILITIES (46 COMPANIES).

The suggestions [of such comparison] deserve the most serious and thoughtful consideration. Death losses, matured endowments, and large expenses attending the outfit and early business of 13 of the companies organized since the beginning of 1866, are among the causes which have probably had much to do with the diminishing ratio of assets, both in their gross and net relations, dropping in the former from 116.53 in 1868 to 108.70 in 1872, and in the latter from 117.65 in 1868 to 108.70 in 1872. But how great a proportion of the annual reduction of these ratios must be charged to extravagant expenditure and imprudent management, we do not presume to suggest. That is a problem for every company to solve in its own behalf. *But comparing the financial status five years ago with that of the present, and with what, at the existing rate of depreciation, it may become five years hence, the prospect is at once grave, if not startling.* In thus presenting this most important matter, we perform only a simple duty. It remains for the managers of life insurance interests to devise and apply such means and remedies as shall strengthen and perpetuate the noble and beneficent institution which they represent.

MORTUARY STATISTICS.

We reproduce herewith, on the same basis as heretofore, the mortuary statistics of another year, believing them to be as accurate as any that can be drawn from the experience of American companies as now reported. It is sometimes claimed that the data furnished by the companies can only give approximate ratios. To some extent this may be and probably is true, yet the results appear to be sufficiently accurate for all practical purposes.

The great increase of mortality throughout the country, and particularly in many of its principal centres of population during the year 1872, is very noticeably indicated in the tabulations compiled for this report. In American, as well as in English life insurance experiences, the mortality of the year was largely excessive. The explanation, however, is evidently not to be sought for so much in the lack of medical care and judicious selection of lives, as in the increase of predisposing or exceptional influences. Were it otherwise, the excessive mortality so universally prevalent might have shown a still higher ratio among insured lives, than in the general population.

As an illustration of mortuary interest, the same companies, which, in their report of death losses to mean amount insured, exhibited in 1868 a ratio of only .82; in 1869, a ratio of .91; in 1870, a ratio of 1.02; in 1871, a ratio of 1.11, now show for 1872 a ratio increased to 1.19. In their new business for 1872, their ratio of death claims to policies issued was .17 against .11; and of losses to amount insured, their ratio was .21 against .12, in the previous year—both very nearly corresponding in their relative comparison with those representing claims on old and new business combined.

Another suggestive fact is, that 21 of the same companies reported no death losses on new business in 1871; while only 6 of the whole number were able to make such report in 1872.

And still another fact of great interest appears in this connection. The companies represented in this report, including the two accident insurance companies, have paid death losses amounting to $87,000,000 during the last five years. Of this large sum, $23,000,000 accrued in the last year alone.

"AMALGAMATION AND REINSURANCES."

Public sentiment is the chief restraint at present operative as a check upon life insurance officers. Theirs is a business which lives upon the public favor, and the check is of great value. A government supervision not only renders efficient service in furnishing facts, statistics, and other evidence upon which public opinion may be intelligently formed, but it goes beyond this. When it appears that the assets of a company are not sufficient to provide for its liabilities, the duty of maintaining an adequate reserve being considered one of them, the department prohibits the company from issuing new policies. Beyond this it does not go in the case of companies incorporated elsewhere. It is to be noticed that the duty of maintaining the reserve is not considered a present liability for any other purpose. A deficiency in the reserve does not necessarily render a company insolvent. At the same time the law as it now stands produces a very decided effect. Insurance managers are well aware that impairment of a company's reserve involves a prohibition of new business. The consequence is, that before their reserve has been so much impaired as to render it too late, the business is usually transferred to some other company.

This course, if equitably carried out, is not without manifest advantages. As a matter of fact, however, a great deal of complaint has been made during the past year on the part of persons residing within this State and holding policies in amalgamated companies in other States. The complaint is that important rights are entirely ignored in the amalgamations that have been made. It is true that amalgamations are usually resolved upon and carried out by the officers without previous consent or authority from the policyholders.

But if an amalgamation is in substance the transfer by a company of its assets, or of the bulk of them, to another company upon consideration that such other company assume all its policies, such a transfer amounts to a discontinuance of business, and is not one of the ordinary transactions contemplated by the charter. Such an assignment, unless made in view of insolvency, is such an act as corporators might naturally suppose would not be committed without the consent of each and every one of them. And if such an assignment is really to be considered as being virtually an act of insolvency, it would be pertinent for the legislature to consider whether under the circumstances of the case an action ought not to be given to a policyholder for the full surrender value of his policy, so that he might not be compelled against his wishes to look to a new company for the performance of his contract. The companies which amalgamate usually profess to have in their possession the full reserve required by law, and ought therefore to be able to pay every policyholder a surrender value that would enable him to obtain a policy equally good with the one he gives up in a company of his own selection. The value of the policies to the holders is, however, enhanced in exact proportion to the degree in which their health is impaired. The consequence is that even if the company, which procures a reinsurance of its policies, allows an average surrender value to any policyholder that requests it, it is not sufficient, if his health is in any degree impaired, to enable him to obtain a new policy in a company of his own selection. No alternative, therefore, is left him, and he is compelled to accept such insurance as is tendered him by the officers of his company.

In the case of amalgamations, the practice in England is for the company which assumes the business to become liable on the original policies. When the business is transferred by this form a question often arises whether the policyholders have agreed to release the first company, and accept in its place the liability of the new one. For the removal of the difficulty it has been provided by act of parliament that a policyholder should not be deemed to have abandoned his claim against the old company and accepted the liability of the new one in lieu of it, unless such abandonment and acceptance have been signified by some writing signed by him or by his agent lawfully authorized. In regard to policies issued before the act, Lord Westbury, the arbitrator appointed for winding up the European, has held that he should require evidence of an intention to make a new contract as plainly expressed as if it were in writing. This formation of a new contract is what is called novation. No reference has been had as yet, in the United States, to the principles which govern it, either because the amalgamations which have been attempted here have been too recent, or because the form in which they have been accomplished has been different.

In this country the managers endeavor, whenever they can, to obtain a surrender of the old policy and to issue a new one in its place. The controversies which have given so much trouble in England may possibly in this way be avoided. Nevertheless, the grievance of the policyholder remains substantially the same. He is practically placed in a position in which he is compelled, whether he will not, to accept the responsibility of a different company from that with which he formed his contract.

Worse than this, he is compelled in many cases to accept a new policy which provides among other conditions, that if a claim arises under it, and is disputed by the company, such claim shall be prosecuted in the State in which the company has its corporate existence.

But the hardship occasioned to the policyholders is by no means the only objection to amalgamations, even as conducted in the United States. There are important difficulties of an actuarial character which require the attention of the managers of the companies. It is supposed to be very easy for a company having in its coffers the proper reserve to reinsure its policies at any time. The natural tendency, however, of a movement towards amalgamation is to produce disaffection. Many of the policyholders refuse to be transferred and surrender their policies, or suffer them to lapse, and it is precisely the least desirable risks which are kept insured and transferred in the greatest number. The profits derived from the surrenders and the lapses are not always sufficient to compensate for the deterioration of the business. Even the practice of cancelling the old policies and issuing new ones in their place, while it obviates the necessity of a recourse to the principles of novation, introduces doubt as to whether the new policies should bear date as of the time of their issue, or be dated back to the time when the original policies were issued. The premiums and the reserve must be adjusted with reference to the dates which are adopted.

——In respect to the St. Louis Mutual Life Insurance Company, the latest excitement has been the onslaught upon it of the State superintendent, and the sucessful defeat of the superintendent by the company. That different examinations into the condition of the St. Louis Mutual Life were in progress has already been noted in previous issues of this Review, and that of the State department has come to a termination with a result not anticipated. Certainly, Superintendent Selby has cleared himself from all suspicion of being the "St. Louis Mutual Life's man"—at least as respects the present administration. We had ourselves recommended, in preference to the State department investigation, one directly pursued in the interest of the policyholders, and such steps appear to have been taken by the insured. Mr. Lewis, the new president, in an address to the policyholders, under date of August 23, states:—

> The former board of directors had invited a full investigation of all the affairs of the company, in the manner provided in the laws of the State, by the superintendent of the insurance department. In the meantime, many policyholders, in whose minds a dissatisfaction had been aroused, asked for an opportunity to make an examination of the books and accounts of the company in their own behalf. Both of these investigations are now in progress, and the result will soon be published.
>
> Meantime, without forestalling the report of the examiners, we may say that, from the results of contemporaneous valuations of the policy reserves by D. P. Fackler, of New York, and Aug. F. Harvey, of this city, and upon the basis of the assets of the company January 1st, last, adding thereto the excess of income over expenditures, the report will doubtless show a surplus over liabilities that will silence all caviling as to the solvency of the institution.

Subsequently, there was an exhibit published of the condition of the company as for June 1, 1873, which was as follows:—

On the first of June, the policies in force were	16,800.	
Amount of insurance		$47,000,000
Reserve at 4½ per cent		6,457,278
Policies in force January 1, 1873	15,641.	
Insurance " " "		$46,387,935
Reserve at 4½ per cent		5,844,036
The income for the first five months of the year is put down at	$1,256,025	
Expenditures	702,940	
	$ 553,185	
The assets of the company on the first of January, 1873, were		$6,514,020
Add net recceipts for five months		553,185
		$7,067,205
Deduct reserve		6,457,278
Surplus over reserve		$ 609,927

This being simply surplus over reserve, has no deduction for unpaid claims. For the first of January, 1873, the Missouri department calculated the reserve at $5,881,186, on the basis of American Experience, 4½ per cent.; the New York department, by the same standard, reached nearly the same result, figuring the reserve at $5,885,660. The foregoing exhibit claims an asset increase of $553,185, against a reserve increase of $613,242. Generally, the State departments, where the St. Louis Mutual Life applied for admission, have credited the company with a net surplus over capital (Ohio being the only exception), and the exhibit for June 1st does not indicate any serious falling off in the position.

Now, in face of such record as the St. Louis has been enabled to make, Superintendent Selby reported, for June 1, the liabilities of the company (not including capital) to be $904,955 in excess of assets. The published account of the superintendent's action was as follows:—

> Mr. Selby, State superintendent of insurance, has filed a petition in the Circuit court at St. Louis, asking for an injunction to restrain the St. Louis Mutual Life Insurance Company from transacting any further business, and especially from issuing any new policies, reissuing any of its risks, or paying out any money whatever. The petition further asks for the appointment of a receiver, and for a decree dissolving the company and winding up its affairs. Mr. Selby's petition is based upon the fact, as he alleges, that an examination of the affairs of the company discloses that its liabilities exceed its assets by $904,955, exclusive of $100,000 capital stock. Mr. Selby also declares that

the list of the policies furnished to him, and upon which the above liabilities are based, is not a list of all the policies issued by the company, but that a large number of policies have been wrongfully cancelled and erased from the books, and all the liabilities of the company thereunder illegally ignored, thereby making the liabilities appear much less than they actually are. A writ of injunction was granted, returnable on the 11th of October.

With such a charge of fraud as is here made, it would be simply impossible to know what is the actual position of the company. The regular monthly meeting of the directors of the St. Louis Mutual (October 9th) following the action of the superintendent, the annexed resolutions were adopted by a vote of 11 to 4, vice-president and director; W. T. Selby, (father of Superintendent Selby,) being excused from voting.

> *Whereas*, William Selby, the superintendent of the insurance department of this State, has recently, and without any previous notice or intimation to this company, instituted a proceeding to enjoin it from the further prosecution of its business, and to place its affairs in the hands of a receiver; and, whereas such proceedings on his part are based upon a hasty and necessarily incomplete examination made of the officers by Mr. Miltenberger, and this suit was instituted immediately upon receiving Mr. Miltenberger's report, and simultaneously with a brief notice to the company that it was "out of line;" now, therefore,
>
> *Resolved*, That in the opinion of this board the action of Superintendent Selby is an unjust, unwarranted, and reckless abuse of the power conferred on him by the law under which he pretends to be acting, and plainly indicates his utter incapacity to properly exercise the responsible duties of such an office; and
>
> *Resolved*, That an institution such as this, possessing, as it does, not less than $6,000,000 of good assets, and abundantly able to meet all its liabilities, cannot be made the toy or plaything of a thoughtless and reckless public officer.
>
> *Resolved*, That this board would regard the appointment of a receiver for the company as fatal to the interests of the policyholders, and will endeavor to prevent such a disaster by all the means in its power.

A removal of the temporary injunction was obtained; but, while the court refused to dismiss the action against the company, Superintendent Selby was flanked and effectively attacked in the rear; and Gov. Woodson called upon the superintendent to resign, on the ground that "serious complaints had been made" against his administration. Whether Selby had any hearing or opportunity to reply to the charges against him, is not stated.

——Two old policies in the Mutual Life Insurance Company of New York, of citizens of New York, illustrate the accumulative value of life insurance on this side of the Atlantic:—

1. Hezron A. Johnson insured February 2, 1843, at age 25, policy $5,000, annual premium $102. By January 1, 1872, twenty-nine annual premiums were paid, making a total of $2,958, and at this date the amount to the credit of the policy was $10,412.05, being $879.13 in excess of the sum of the annual premiums at 7 per cent. compound interest, viz.:—

Insurance at end of 29 years	$10,412 05
29 annual premiums at 7 per cent. compound interest	9,532 92
Insurance gain over 7 per cent. compound interest	$ 879 13

The policy, which is still in force, receives an annual addition of $240, which is $138 more than the annual premium.

2. A policy on the life of Cyrus W. Field for $10,000, issued several years since at $198 annual premium. With twenty-eight annual premiums paid ($5,544), the result stood as follows:—

Total insurance	$19.802
Annual premiums at 7 per cent. compound interest	17,095
Insurance gain over 7 per cent. compound interest	$ 2,707

While it is not intended by this to claim that the life assets have improved at more than, or even as much as 7 per cent., the examples yet demonstrate that for the *insurance purpose* they have so enhanced—the sums named being due in event of death.

The yearly addition to the policy of Mr. Field is now $500, making the present or cash value of the additional insurance far in excess of the annual premium.

——THE Mutual Life Assurance Society of London, an office of forty years' standing, makes the following concessions to policyholders in its conditions of insurance: "Policies are unforfeitable and unchallengable after five years old and the life has reached thirty. Under same conditions the assured may travel where he likes without extra premium. Death by suicide, duelling, or the hands of justice, does not invalidate a policy. Even during the five years, accidental omission to pay premiums does not invalidate policy. Assigned policies are of full value to a *bona fide* holder, no matter how short a time they may have been in force."

——THE National Convention of chiefs of fire departments began in Baltimore, October 20th, and terminated its sessions October 23d. Chief engineer Damrell, of the Boston department, was chosen president. This body convened under a definite programme of inquiry, and the business was pursued in a systematic manner. The subjects for consideration and the action of the committees were classified under the two general heads of—1st, prevention, 2d, extinguishment of fires. The first took in the origin and superinducing causes of combustion, with adequate inquiry into the occurrence of every fire; involving the questions of form of structure, building materials, storage of merchandise, watchmen, incendiarism, fire escapes, &c. The second the efficient organization and combination of all agencies in fire suppression, timely discovery of fire, and quickest effective application of water; also, the special consideration of checks to extension of flame and rescue of endangered property. We note that in proposed regulation of the storage of petroleum one reason assigned was for the prevention of its spontaneous combustion. This involves a debatable point. Petroleum, recognized as of rapid and intense inflammability, is not in its chemical study known to be liable to spontaneous ignition, being held to be rather repressive of oxidation than otherwise. The convention appreciated the necessity of a thorough understanding between underwriters and those engaged in discovering and extinguishing fires. A selection from the insuring body was added to the permanent committee on reports, and the Baltimore Underwriter was chosen as the organ of the convention.

——IN an indirect way, panics produce puzzles in life insurance as well as in currency theories. First, a life company must not be run upon as a bank, because, essentially, the policy contract stipulates for principal to accumulate undisturbedly at compound interest, with assets funded; second, cash surrender values set up a life company to be run upon in troubled times, like a deposit account, and necessitate moneys to be ready at call; third, under such contingency, a life company must bank for interest as well as safety, outside of floating balances, or accept demand loans with collateral; fourth, when the rush comes for surrender values, as lately shown in New York, the trust companies close up, and the collaterals depreciate below the margin of excess over loan—consequently the money which should meet the sudden demand is not to be got when wanted; fifth, as the cash surrender rule entails a contingency of loss not belonging to a reversion, and as all risk in insurance requires compensation, it is plain that cash surrender value should be less than present value of the reversion; and the puzzle is, how to calculate panics—it being understood that surrender of policies under such circumstances will come more from the embarrassed condition of the insured, than from doubt as to the stability of the company.

——BY the life report of Commissioner Wailes, the two Maryland life insurance companies had at the close of 1872 $798,543 of assets and $736,185 of liabilities, including capital. The capital of the Mutual Life of Baltimore was impaired $13,439. Total income of the two companies, $225,277; outgo, $147.49. Total policies issued 874, insuring $1,361,473. The 44 life companies of other States authorized to do business in Maryland issued 4,285 policies, insuring $10,096.018; premium receipts, $1,708,243; losses paid, $854,762. Total policies in force at close of the year, 16,603; insurance, $47,967,155.

——NEW YORK city had its biggest fire in 1835, as is well known. This fire was followed by an extraordinary advance in fire insurance premium. The Croton dam was begun in 1837, and the aqueduct completed in 1842, at a cost of about $12,000,000, and then the insurance premium fell off at an average of about 40 cents on the one hundred dollars! When the work was finished it was thought the Croton water would be sufficient for a population of 5,000,000—since shown to be a very wild estimate.

——THE Association of Fire Undewriters of Philadelphia held its annual meeting October 21—Charles Platt, Esq., was reëlected president, and E. B. Merrill, Esq., secretary.——MR. GEORGE CLAUSSENIUS has been appointed general agent of the Penn Mutual Life for the Pacific coast.——THE Missouri Valley Life Insurance Company has been authorized to transact business in Pennsylvania—Mr. C. E. Rollins, general agent.

——Owing to an omission of one or two words in our item in October Review respecting the Hope Mutual Fire Insurance Company of Philadelphia, what we designed to express has been misunderstood. The astonishing part to us of Commissioner Forster's disclosure was the extent of the premium on outstanding risks in both branches of the company's business, viz., the stock and the mutual department. We would have hardly committed ourselves to the opinion that premium notes in the *mutual* department were assets against the liabilities of the *stock* department. The matter of a defined reinsurance reserve pertains to stock fire insurance—has nothing to do with assessable premium notes. Mr. Forster examined the Hope as a company having a reputed paid up capital stock of $225,000. Setting aside the premium notes as presumably good for the liabilities on the mutual policies, he proceeded to value the stock assets and stock liabilities of the company, and made the result public. Since the commissioner's exposition the Hope announces that it has transferred its stock business to another company, and proposes to run hereafter on the mutual basis alone.

——Is the apotheosis of Superintendent Church, of the Ohio department, now to commence? Having been abused and vilified without stint, the time has come for the tune to be changed. So we put in our protest in advance against any over-exaltation of this official. In his exclusion of the North Missouri from Ohio, after it had fallen from the progress and prosperity of its earlier career, we saw no ground for condemnation, and his rejection of the St. Louis Mutual Life is now on trial as to its justice; but whatever proofs time may bring on these two points, we condemn the spirit and rules of his general administrative policy. As an inspector of companies he is great, perhaps the most penetrative in this respect of all the men that have been given charge of insurance departments, but as superintendent we rate him much lower.

——Is the house of the St. Louis Mutual Life divided against itself? Are there any stockholders who would seek a profit by wrecking the institution? At the directory meeting, October 9th, Mr. Ashbrook said "that he had heard one large stockholder express the opinion that it would be to his advantage to have the company wound up." Now are there other shareholders of the same opinion? and if so, how far is the distance between opinion and practice? Mr. Donovan, the largest stockholder in the company, and elected director from the Peck ticket, expressed a contrary opinion. He "could not see how any stockholder's interest could be helped by going into liquidation."

——To the victims of the yellow fever in the Southwest is added Mr. H. A. Littleton, who died at Memphis, Tenn., October 8th. Mr. Littleton was the author of Littleton's Insurance Digest. His insurance agency was one of the largest in his section, and he was the first president of the Mississippi Valley Fire and Marine Insurance Company. The deceased was a gentleman of superior intelligence as an underwriter.

——A State board of health has been started in Michigan. The new board has as secretary and superintendent of vital statistics Dr. Henry B. Baker, probably the best man in the State for the position. We can so commend Dr. Baker without deserving the charge of undue partiality, as we have heretofore criticised rather freely his zealous and honorable labors in this department of social science.

——Superintendent Chapman, of New York, is examining *all* the State life companies, and by such commendable course casts no suspicion upon any of them. While not on a general smashing tour, we may presume the superintendent will put himself in such nearness to the actual facts as will be a check on misrepresentations in the statements for 1873. The National Life, of New York, showing assets $544,000, liabilities $713,000, an application was made for the appointment of a receiver, and Mr. Eli Beard, president, was appointed by Judge Fancher.

——In the United States Circuit court, Richmond, October 14th, the case of Hancock *vs.* the New York Life, was decided against the company, and a verdict was rendered for $1,371. The question was the liability of Northern companies for the amount of premium paid before the war on policies lapsing during the war, and companies refusing application for renewal after the war closed. The verdict was for the premiums paid and interest thereon.

——Thanks for Vol. V, bound, of the Insurance Times. The Times is *sui generis*, and preëminently the leading record of the bitterest insurance controversies of the period. Its editor is the William Cobbett, of the insurance press, and his writings are excellent as a stimulant, if not as a tonic.

——The local board of fire underwriters in Bangor, Me., has voted to charge extra-hazardous rates on all buildings in which more than 10 barrels of kerosene are stored. The leading merchants have voted to sustain the underwriters, and the city council are asked to pass a restrictive ordinance.

——A company, says the Insurance Journal, which has done a very large business in fire risks, lately decided to go over all its experience on this class of business, and the result shows "a loss of 25 per cent., without taking account of expenses."

——While tremors are afflicting certain companies at the visitations of Commissioner Forster, the new Safeguard of Philadelphia comes out with a statement: Assets, $226,063.29; liabilities, $16,628.69.

——The matter of Fox against the Penn Mutual Life, of Philadelphia, still keeps in the newspapers. As the courts are fully competent to decide upon the question at issue, *why* this advertising of it?

——Whether a claimant for death loss is a preferred creditor in the winding up of a life company, is a question to be adjudicated in the disposal of the assets of the late Hercules Life.

——The Franklin Fire Insurance Company of Philadelphia continues the golden monotory of a quarterly dividend of 8 per cent. coin, the last one payable on and after October 15th.

——Messrs. Duy & Woods have been appointed agents in Philadelphia of the Life Association of America. This firm has lately removed from its old quarters to 412 Walnut street.

——J. A. Stephen, cashier of the St. Louis Mutual Life, disappeared September 30th, so also did $6,500 in currency. His accounts were examined and pronounced correct.

——New York city, with a population of 1,000,000, had an average of 3.7 fires per day in 1872. London, with a population of 3,500,000, had 4.1 fires per day.

——M. Eugene Reboul, whose flashes of epigram are the jewels of French life insurance literature, is at the head of the new life company L'Atlas.

RAILWAYS AND TRANSPORTATION.

A LIVELY discussion of the transportation question may be expected in congress at the coming session. It has become very evident, notwithstanding the charges of rapacity, extortion, &c., so freely made against the railway companies, that the real difficulty is that there is a scarcity of railway facilities, and an apparently insurmountable limit to expenses, and that these constitute the real cause of the present prices of transportation. The "granges" themselves tacitly admit these to be the main reasons for the present expense of shipments, by memorializing congress upon the subject, and asking that body to construct and operate an exclusively tonnage road between Chicago and New York. They assert that such a road, worked at a speed of about 7 miles per hour, would be capable of transporting 450,000,000 bushels of wheat each way, and at this rate of speed could be managed very economically. Leaving out the question of the constitutional power of congress to enter into the construction of public ways other than post or military roads—and it can hardly be contended that the one proposed falls under either category—the attempt by any government to build or operate any economical route would probably end in a costly failure, and would in effect be taxing the multitude for the few. The governors' convention at Atlanta, which seems to have seen the need of more transportation facilities quite as clearly as the farmers, differed from them both as to cause and remedy. It held the true cause to be the great expense of land carriage, and advocated the construction of canals. But the great natural canal, the Mississippi, although capable of transporting the commerce of the world, is used but little for grain carriage, even where it is for export, and what reason can be urged for spending immense sums in constructing a water way almost parallel to the Mississippi, and but a short distance farther north. The general assembly of Virginia has submitted a memorial to congress proposing to release to the general government the James river and Kanawha canal, if congress would expend $50,000,000 or so in completing communication between the Ohio river and the Virginia capes. But what will it avail to complete this communication? Pennsylvania had communication once through about the same topography, and has abandoned the costly experiment. The Erie canal is a success only from the fact that it is constructed through the only practicable path between the East and the West, yet the New York Central road thrives in competition with even this water way. With the Mississippi unused, and the Erie canal occupying the only level route, why should congress spend money in essaying the problem of a passage of the Alleghenies, which has been already demonstrated by the States of Pennsylvania and Virginia. The inadequacy of the means of communication between the East and the West has not escaped the notice of the railway kings, and they are already making preparations to supply the deficiency as fast as money can be found to do it. The New York Central company already has an exclusively freight road between New York and Buffalo well advanced, and the Pennsylvania Central is not only following rapidly with two additional tracks, but is also contemplating the construction, if not stopped by the combined effect of the monetary embarrassment and the granges, of a new communication between the Atlantic and the Mississippi, by way of the Cumberland and the Shenandoah valleys and central Tennessee.

——WE collate from the annual report of the operations of the East Tennessee, Virginia and Georgia Railroad Company, for the year ending June 30, 1873, as follows: The company was formed in 1869 by the consolidation of the East Tennessee and Virginia and the East Tennessee and Georgia companies, and now owns a line from Bristol, Tenn., southwest, to Chattanooga, 242 miles, with a branch from Cleveland, Tenn., to Dalton, Ga., 27 miles—making a total of 269 miles operated. The present aspect of the funded debt shows:—

Funded debt, including bonds given United States government in settlement of former indebtedness	$4,191,900 00
From which should be deducted cost of Morristown and Rogersville roads, which will be returned hereafter	453,906 28
Leaves, funded debt	$3,737,993 72
Against funded debt at time of consolidation, 1869	5,664,789 32
Reduction in 4 years	1,926,791 60

There is practically no floating debt.

Comparative summary of earnings and expenditures:—

	1873.	1872.	*Increase.*
Gross earnings	$1,378,358 46	$1,201,491 77	$176,866 99
" expenses	929,148 42	834,800 38	94,348 04
Net earnings	449,210 04	366,691 39	82,518 74— or 18¾ per cent.

The report congratulates the stockholders on a considerable increase of through business from the Memphis and Charleston railroad, and mentions a loss of through business from the damage to the business of the Rome and Dalton road through litigation.

The policy of the company has been to apply the surplus earnings to the improvement of the company's property, but this year that rule is departed from, and a semi-annual dividend of 3 per cent. on the capital stock, payable October 1st, was declared.

——THE Atlanta and West Point (Georgia) railroad has published a report of its operations for the year ending June 30, 1873, from which it appears that the road owned by this company is 81 miles in length, and it leases 6 miles of the Macon and Western road from East Point to Atlanta. The fixed capital account is—capital stock, $1,232,200; funded debt, $102,500; total, $1,334,700; or $15,478 per mile.

	1873.	1872.	*Decrease.*	
Total earnings	$399,344	$413,078	$13,764	
" expenses	299,183	333,365	34,182	
				Increase.
Net earnings	$100,161	$79,713		$20,348

This shows a greater economy of management, as, with a decrease of 3¼ per cent. of gross earnings, the net earnings are increased quite 25 per cent. This is well, but there is room for further economy, for while this road earns the extraordinary percentage of one-fourth of the capital invested every year, the expenses run from 67½ to 75 per cent. of the earnings.

——AN American company has commenced in Brussels to build sleeping cars on a large scale; the prejudices of the European engineers and the number of companies working without coöperation will prevent the full development of the system at present, but will probably be overcome in time. The engineers persist in limiting the length of the cars to 35 feet, which makes it impossible to accommodate more than 16 persons comfortably in a car. The system of coöperation is so wretchedly poor that travellers are frequently obliged to change cars several times in a night; and there is also the annoyance of frequent searches and inspection of passports by government officials. Commerce, however, is an almost irresistible leveller of red tape and formality, and it is more than likely will prevail in the end, as it has over other restrictions of a like character.

——ENGLISH engineers are discussing the problem of the speed of railway trains. It is stated that the highest speed of trains is made in England on the Great Western railway, where it is given roundly at 50 miles per hour. Seventy-five miles per hour is occasionally reached, and the question is discussed whether 100 miles per hour might not be safely attainable. Both these questions seem to be decided negatively—first, because no considerable length of track can be constructed on which such a rate of speed could be safely maintained over its entire length; and, second, that the mechanical genius of the age is not sufficient to construct a locomotive capable of drawing a moderate train at that rate of speed.

——As recent events have drawn public attention to the financial condition of the Northern Pacific railway, the appended statement, condensed from the one lately published by the trustees' agent, Mr. Nettleton, will be read with interest. The company is now operating the Minnesota division, 228½ miles in length; the Dakota division, 200 miles; the Pacific division, 105½ miles; and the Lake Superior and Mississippi River road, under lease, 131 miles; making the entire length of road operated 740 miles. The rolling stock consists of 72 locomotives, 1,520 freight, and 57 passenger and other cars. The eastern division of the road connects at Duluth with the commerce of the great lakes and at St. Paul and Minneopolis with the Eastern railway system. At the crossing of the Red river it receives the trade of the British provinces; at Bismarck it connects with the commerce of the Missouri river, and is at this point within 30 miles of vast and valuable coal deposits, which, when reached, will add largely to the volume of business. The western division connects at Kalama with the Oregon Steam Navigation Company's boats, which are controlled by this company, on the Columbia river, and through them the most valuable carrying trade of Oregon and Washington Territory, and connects at Tacoma on the north with the vessels of the North Pacific Steamship Company and the trade of Puget sound.

The company has now acquired title to 10,732,800 acres of land, and the titles do not depend upon the completion of the road across the continent, and it has received patents for 649,000 acres, and the remainder will be patented as soon as the necessary surveys and clerk services can be had. There have been sold upwards of 94 square miles of land at an average of $5.48 per acre, at which average price the company's lands now acquired are worth upwards of $55,000,000, or about double the cost of the road already constructed. The bonds of the company constitute a first mortgage upon the lands as well as upon the road bed and franchises, and are exchangeable for land valued at from $2 to $9 per acre at $1.10. The earnings of the road have not yet been sufficient to pay the interest upon the cost of construction, but have been quite up to the average of new roads, and are increasing rapidly.

From other sources it appears that the total amount of 7 per cent. bonds authorized was $30,000,000. Of this amount $23,000,000 were disposed of by Jay Cooke & Co., and the remaining $7,000,000 were taken by Gen. Cass and some of his friends, independent of this firm. It was not expected to do more than grade the 30 miles of road to the coal measures this fall, and lay the iron in the spring. Arrangements have also been made to expend about $50,000 for building snow fences and generally preparing for winter this fall, and these contracts comprise all of the company's indebtedness—all the old indebtedness having been settled upwards of three months ago, and the receipts being ample for monthly expenses.

——English railroads carried 400,000,000 passengers last year, with 1,500 accidents to passengers, and 636 accidents to employés—213 of the latter fatal. The Prussian railways carried over 62,000,000, with 782 accidents to passengers. This would seem to indicate that British railways are much better managed than continental roads—the more so as it appears that the English roads have not more than one-fourth the depot room that the Prussian roads have, and are obliged to care for their myriads of passengers in very cramped accommodations. There is another aspect to this showing which those who wish to put the roads under government supervision would do well to ponder. The continental roads are all more or less under government control, and the more government control the greater the ratio of accidents and delay in the dispatch of business seems the rule. Of course so many considerations enter into a question of this nature that it is well-nigh impossible to ascertain and fix the responsibility for accidents upon one or the other system; but it does not need much penetration to discover that the very best governmental supervision must fall far short of that which every one exercises over his own interests. And the only way in which the government can control railways is to inflict such moderate pecuniary and other punishment for accidents as will make it the interest of every railway corporation to prevent such as are the result of negligence, and safely leave to the companies themselves the means to be used to accomplish this result.

These suggestions are made under the hypothesis that railway officials are negligent in discharge of their duties as charged by those who advocate governmental supervsion, but we are by no means prepared to admit that such is the case. It seems to us that the travelling public are much safer and better cared for to-day—when the speed of travelling has much increased—than ten years ago, and incomparably greater than before the advent of railways; and who ever heard of putting stage coaches and canal boats under government supervision.

——A REPORT presented by the secretary, at the last convention of the Master Car Builders' Association, shows that the number of car builders in the United States and Canada is 103. At the close of the year 1871 there were in these countries, on roads of 4 feet 8 inches and wider gauge, 193,767 8-wheeled cars, and 58,355 4-wheeled. The number reported on narrow gauges was 212. There were constructed by these companies during the year ending May 31, 1873, 36,765 cars, of which 713 may be classed as passenger, 150 baggage, smoking, and postal, 455 for special purposes, such as paymasters, caboose, construction, &c., and the remainder are different forms of freight cars. In addition to these the different railway companies have constructed during the same period 22,345, making the total number in existence May 31, 1873, about 340,000, and the increase for that year of about 25 per cent. These figures are believed to be rather under than over the mark, even taking into account the perishable nature of this species of manufacture, and yet the increase has not kept pace with the demand.

——THE National Board of Steam Navigation commenced its second annual convention in Philadelphia on the 17th of September. The board has for its object the advancement of the interests of those interested in steam navigation on the waters of the United States, and the most potent evil with which it is now contending is the unadvised and hasty legislation of congress. That body, urged by an unthinking public, has passed several acts ostensibly for the protection of the travelling public, but practically working for the benefit of several more or less valuable patents, and burdening American vessels with restrictions from which foreign vessels are exempt. So it is to be hoped that the National board may succeed in its aims.

——WILMINGTON, Del., is congratulating itself that the Wilmington and Reading railroad is about to end its dependence upon a hostile corporation, and put itself entirely into the hands of its friends. This means that the Berks County railroad, connecting the Wilmington and Reading road with Slatington, on the Lehigh Valley road *via* Reading, is nearly finished, and when fully completed will furnish another competing line to the coal regions of the Lehigh and Schuylkill. The more competition in the carriage of such freights the better for all concerned.——THE convention of prominent railroad men, which has been in session at Chicago for several days discussing the feasibility of constructing a direct line from that city to the southern Atlantic coast, adjourned October 10, after adopting resolutions to assist in the construction and success of the enterprise. Nothing definite was accomplished, no route being designated, and no real commencement made, and the panic repression will probably take care of it in the future.——ANOTHER railroad between Philadelphia and Baltimore is reported to be in progress of construction. The line is intended to be an independent one, not connecting with any road now running out of Philadelphia. The road will run *via* West Chester, Oxford, Towsontown, and Lake station, on the Northern Central, &c., and the right of way, it is stated, has been secured throughout the entire length, with the exception of a few lots in Towsontown and a short distance beyond the Gunpowder river. Twenty miles of the route have been located, and a section six miles in length has been graded. The Maryland and Pennsylvania and Juniata and Pennsylvania State line roads are reported as being the chief spirits in the enterprise.——THE double track of the East Pennsylvania railroad is nearly completed from Allentown to Reading. A double track is also being put down by the New Jersey Central Railroad Company between Elizabeth City and Easton, and this is to be followed by the laying of a second track on the Lebanon Valley railroad, which will give a continuous double track line from Harrisburg to New York.——THE Hoosac tunnel progressed during the month of September 316 feet, leaving, October 1, 552 feet still unopened.

Patents, Arts, and Science.

[This Department is under the editorial charge of William H. Wahl, Ph. D.]

THE iron market may be characterized as utterly prostrated; prices show a continuous decline since our last monthly summary. There have been very few sales (mainly higher grades), even the demand for immediate use falling off. All signs point to a decrease in the consumption of iron for some time; for railway iron, no market. There is some increase of stock on hand at furnaces, but we have reports that fifteen furnaces in Lehigh district have blown out, and six in the Schuylkill district. Stock of Scotch iron abroad, October 3, 39,642 tons—a reduction of nearly 100,000 tons since same date in 1872. Total shipments during September, 42,779 tons, against 61,382 tons same month last year. Direct September shipment to Philadelphia, 1,655 tons. Our quotations for American irons are asking prices; buyers and sellers are apart in their views. Scotch pig is selling at from 10 per cent. to 15 per cent. below our subjoined importation rates.

September–October Iron Report.

	27th.	4th.	11th.	18th.	25th.
American Foundry Pig:—					
Lehigh, No. 1	$41.00	$40.00	$40.00	$38.00	$35.00
“ No. 2	36.00	36.00	36.00	32.00	30.00
“ “ (plain)	34.00	34.00	32.00	28.00	26.00
“ No. 3 (gray forge)	32.00	30.00	30.00	27.00	25.00
“ No. 4 (mottled)	28.00	28.00	28.00	25.00	24.00
“ White	25.00	25.00	25.00	22.00	20.00
Schuylkill, No. 1	41.00	40.00	38.00	37.00	35.00
“ No. 2	36.00	36.00	35.00	32.00	30.00
“ Gray forge	30.00	30.00	29.00	27.00	25.00
“ Mottled	28.00	28.00	27.00	25.00	24.00
“ White	25.00	25.00	25.00	22:00	20.00
Scotch Pig:—					
Gartsherrie	48.82	49.00	47.04	45.83	45.69
Coltness	49.51	49.00	47.71	46.09	46.21
Summerlee	47.48	46.96	45.70	44.53	44.41
Langloan	47.48	46.96	45.70	44.53	45.05
Calder	47.48	46.96	45.70	44.27	44.79
Carnbroe	46.93	46.96	45.18	44.27	44.15
Glengarnock	47.21	46.82	45.44	44.02	44.15
Eglinton	46.12	46.02	44.64	43.88	44.15
Dalmellington	46.12	45.74	45.18	43.88	44.15
Old rails, D.H.'s	45.00	44.00	43.00	42.50	42.50
“ T's	44.00	43.00	42.00	41.50	41.50
English rails (ex. ship.)	72.50	70.00	70.00	68.00	68.00
American rails (manufact'd in Penna.)	75.00	75.00	72.50	72.50	72.50
No. 1 Wrought scrap	40.00	40.00	40.00	37.00	37.00
Cast scrap (machinery)	30.00	30.00	30.00	27.00	27.00
Stove-plate scrap	25.00	25.00	25.00	23.00	23.00
Wrought turnings	33.00	33.00	33.00	32.00	32.00
Cast “	25.00	25.00	25.00	25.00	25.00
American refined bar	$3\frac{5}{10}$c.	$3\frac{5}{10}$c.	$3\frac{4}{10}$c.	$3\frac{2}{10}$c.	$3\frac{2}{10}$c.
“ common bar	75.00	72.50	72.50	70.00	70.00
Railroad spikes	.04	.04	.04	.04	.04
Nails (⅌ keg)	4.75	4.75	4.75	4.75	4.75
Street rails (deliv'd on car, Broad & Willow).	75.00	75.00	75.00	75.00	75.00

——We receive from Mr. Elbridge Wheeler the following communication on the practical relations of iron and steel, designed to show that the tenacity of the one and the durability of the other in conjunction cannot be attained by any compromise in carburization, but that the absolute combination of two distinct metals is necessary—all assertion to the contrary notwithstanding—such combination, as a welded union, being effected by Mr. Wheeler's process:—

Office of Pennsylvania Combined Iron and Steel Association,
Philadelphia, 220 Walnut Street, October 22, 1873.

Editor American Exchange and Review:—

There has of late been considerable discussion upon the subject of iron and steel, and we think, according to the best information that can be obtained, no one ever had better opportunity for testing the relative properties of steel and iron than Sir William Armstrong, with the kingdom of Great Britain to back him.

Sir William says: "It is impossible that I can hold any other opinion than that the vibratory action attending accessive concussion is more dangerous to steel than to iron;" and we think that years of experience in the manipulation of iron and steel fully attests the correctness of his opinion.

What we desire to impress upon the public mind is the importance of the TWO METALS COMBINED for such purposes, and in such proportions as are best adapted for the uses they may be intended; and further, to give a few facts in the working of steel by our process, which we think of great utility, and which, so far as we know, has never been accomplished by any other process.

We contend that steel cannot be made to answer the purposes of steel and iron at one and the same time; that is, in fact it must be either steel or iron—hence high grades and low grades of steel, as they are termed, and the lower grades but little if any better than the best grades of iron.

It has been said that no one could tell where iron leaves off and steel begins, but we think steel commences where iron *presents carbon*, and steel is no longer steel when it has lost its carbon, for it is *carbon* that makes steel.

At a recent convention of the American Railway Master Mechanics' Association, held at Baltimore, it was contended that steel axles did not wear as long as iron. The reason is obvious. No engineer would think of using a car axle made of *steel proper*—that is, of steel high in carbon, which would give the necessary wearing property—but must have steel that will stand the axle test of iron; consequently it is but iron, or a very low grade of steel, which for wearing purposes is no better than iron.

A similar difficulty arises in the manufacture of *railroad rails*. Steel that is best adapted to wearing purposes is liable to sudden fracture, and would not be considered safe "under accessive concussive strain," quoting a well known author; therefore, the Bessemer steel rail has but the slightest amount of carbon, or barely enough to distinguish it from iron.

We claim that we have a process that will make safe and reliable high grades of steel under any and all circumstances, giving longer life to rails and axles, and safe and reliable as the best iron, by combining iron and steel together.

It is a well known fact that ingot steel is more or less open, porous, or spongy, and that no amount of blooming or hammering unites or welds the particles, from the fact that a welding heat cannot be taken upon the ingot after leaving the mould; by our process we can safely bring an ingot to a welding heat, and finish it into a bar at the same heat without in the least detracting from the quality of steel.

Yours respectfully,
Elbridge Wheeler, Vice-president.

——The local press has of late contained statements to the effect that for the last two months there has been a rapid falling off in the car-building business in Wilmington, Del., one of the most extensive industries of that locality. The reason first given for this state of affairs was that the builders were unable to obtain orders for new cars for cash, and as they did not care to take in payment the bonds of the various railroads wanting cars, they were obliged to suspend operations on new work, and only attend to such cars as were sent on for repairs. On the other hand, it is asserted, that the reason for this contraction of operations is to be found in the ultimate intention of the firms to reduce the wages of their employés.

——The fourth industrial exposition held in Cincinnati, which, when these lines are read by our readers will have closed, has upon all sides been characterized as the most successful exhibition of arts and manufactures ever held in America.

We present herewith a full plate illustration of the buildings in which this display was made. These are five in number, including the art hall, which is connected with the rest by a covered bridge extending across Elm street, as may be observed by an inspection of the engraving. The exhibition, as in former years, was conducted under the direction of a board of commissioners appointed conjointly by the chamber of commerce, the board of trade, and the Ohio Mechanics' Institute, and was supported by a public guarantee fund on the part of the citizens of that enterprising city. It will thus be seen that the exhibition was the exponent of the enterprise of the prominent citizens and business men of the city, making it essentially a municipal, and not a private, undertaking. The character and extent of the exhibits in former years, and especially in the present exhibition, have given to the enterprise a standing far higher than that of a merely local display, since they number not only articles of art and industry from all parts of the Union, but also from England, and very generally from continental Europe.

Description of Buildings and Dimensions.—The dimensions of the ground plan of the buildings are as follows: Main hall, 110 x 250 feet, height 75 feet; north hall, 113 x 350 feet, height 45 feet; power hall, 172 x 192 feet, height 47 feet; floral hall, including offices, 140 x 150 feet, height 50 feet; art hall, 62 x 160 feet, height 35 feet. The available exhibiting space, including upper floors, galleries, and walls, is nearly eight acres. The space occupied by aisles this year is considerably less than that of several years previous, probably not being more than 30 per cent. of the total floor space. The management, very early in the season, made well-directed efforts to secure reduced fares for visitors to the exhibition by the various railways and steamboat lines entering the city. These efforts were successful, and quite a number of transporting lines acceded to the desire of the management and of the public by affording reduced fares to visitors.

The exhibiting space covers about eight acres, all of which is under cover. As the buildings occupy all the area available to the management of the enterprise, there was no opportunity of enlarging them this season, although the exhibition of last year completely occupied every available place, and the applications for room this season indicated that a much greater floor room could have been utilized.

The main building is of wood, and the exhibiting space is so divided as to leave several broad aisles. In the centre, where these aisles converge, there is placed an elaborately decorated pavilion sixteen feet in diameter, and reaching nearly to the roof of the hall. The horticultural hall is tastefully decorated with rustic grottoes, fountains, vines, ferns, and various plants most attractively arranged. Very thorough precautions were taken throughout the duration of the exhibition to prevent destruction by fire. Six firemen, regularly detailed by the city fire department, were stationed in the building at all times. Six fire plugs, with an abundant supply of hose, a steam fire engine, three carbonic acid gas engines mounted on wheels, besides several portable fire extinguishers, may be mentioned amongst the means at hand to prevent accident from this source.

The classification of articles for exhibition as adopted by the management was as follows:—

Department A.—Machinery, including steam engines and boilers with their fittings, water-wheels, and other hydraulic machinery, electric engines, and other prime movers, metal and wood working machinery, sewing machines, and other machines for special purposes too numerous to specify.

Department B.—Agricultural machinery—plowers, mowers, reapers, threshers, seed drills and their attachments, grinding and feed mills, grain separating and cleaning machines, cane and cider mills, sugar evaporating machinery, &c., &c.

Department C.—Iron, steel, metals, castings, &c., &c.

Department D.—Railroad supplies.

Department E.—Cooking, heating, and ventilating apparatus.

Department F.—Building materials and general hardware, including, amongst other objects, building and general hardware, edge tools and cutlery, undertakers' goods, marble and slate mantels and imitations, gas and lamp fixtures, plumbers' goods, sheet iron, copper and brass work, locks and safes, carpenters', joiners', carvers', stair-builders' work, &c., &c.

Department G.—Domestic manufactures—boots, shoes, findings, leather, morocco, hose, belting, harness, trunks, mirrors, musical instruments, carriages, tobacco, segars, cured meats, confectionery, wines, stationery, &c., &c.

Department H.—Of the household—furniture, billiard tables, paper hangings, papier-maché, refrigerators, china, glass, and earthen ware, wood and willow ware, &c.

Department I.—Chemicals, drugs, apparatus, and appliances.

Department K.—Scientific, including philosophical, mathematical, photographic, telegraphic apparatus, surgical and dental instruments, &c., &c.

Department L.—Textile fabrics—woolen and woolen mixtures, cotton goods, flax, hemp, cotton, hats, caps, furs, &c.

Department M.—Ladies' articles—very numerous.

Department N.—Natural history, geology, antiquities, &c.

Department O.—Unclassified articles.

Department P.—Fine arts, including oil and water color paintings, pencil and crayon drawings, steel, copper, and wood engravings, marbles, bronzes, lithographs, architectural and other designs, photography, &c.

Department Q.—Horticultural—floral, fruits and vegetables, &c.

Of the rules and regulations adopted by the management for the government of the exhibition it is unnecessary to specify anything, beyond the fact that everything requisite to the thorough systematization of the display and the preservation of harmony and discipline was well matured and adhered to.

Of the multitude of articles and machinery on exhibition it would be useless to attempt, in our limited space, even a fractional enumeration. We have only room to refer briefly to the exhibition of machinery in power hall, which formed one of the principal features of the exposition. This department covered nearly an acre of ground, and contained about 400 machines, of which not less than one-half were in operation performing their multifarious functions, making a display of almost infinite complexity. The steam for driving the four main lines of shafting and the numerous independent engines in various parts of the hall was furnished by two batteries of steam boilers outside the building. Power was furnished by three steam engines. The display of wood and iron working machinery is said to have been unprecedentedly large.

Of the success of the exhibition the universal verdict of its half million of visitors was, that it has proved to be the best exhibition of the industrial arts ever held in the country. The financial portion of the enterprise—possibly the most sensitive test of success, too, indicates the same verdict—the receipts having exceeded the payments by $15,000.

The arrangements for holding a fifth annual exposition under similar auspices were, in consequence of the unqualified success of the one just passed, effected without difficulty or delay. We can only wish the coming exhibition to eventuate as creditably to its inaugurators as its predecessors.

——The occurrence of indium (one of the rarest of the elements) in zinc blende, from several American localities, has been determined by Mr. H. B. Cornwall. From Roxbury, Connecticut, a blende was obtained so rich in indium that it could be detected spectroscopically by examining the raw powdered material without any preparatory chemical treatment.——In a paper on the spontaneous ignition of hay, Mr. H. Reinke states, in a German exchange, that in consequence of prolonged fermentation, hay can become transformed into a true coal, which, when exposed to the air at somewhat elevated temperatures, acts as a pyrophorus.——The reconstruction of the Tuileries is to be commenced. The fire of May, 1871, so calcined some of the ruined stonework that it crumbles to powder at the slightest touch, and extreme caution has been required to prevent the occurrence of accidents to the workmen engaged in the demolition of the ruins.——It is announced that two first-class locomotives have recently been turned out of the South Carolina railroad shops, at a cost, it is claimed, considerably below Philadelphia prices, and of a quality, according to the local press, fully equal to the best Northern engines.

——PROF. NORDENSKIOLD, the great Arctic traveler, has communicated to the French Academy the following information. The communication states that, in December, 1871, the largest fall of snow within the memory of the oldest inhabitants took place at Stockholm. It lasted five or six days, and caused the loss of several lives in the surrounding country. With the object of determining whether or not the impurities of the atmosphere had been swept down during the first days of the storm, the writer carefully collected some of the snow corresponding to that period, and melted it to determine the presence or absence of any solid residue in it. He found it charged with a considerable quantity of black substance resembling soot, but really consisting of organic matter rich in carbon. It also contained small particles of metallic iron, a fact which forcibly recalled the circumstance of the fall of meteoric dust at Hessle, near Upsal, on the first of January, 1869. Suspecting the chimneys of the city to have supplied these materials, the writer requested his brother, living in Finland, to repeat the experiment. The latter did so, taking the snow from beneath the trees of a forest, remote from all inhabited places, and found the same black matter in it, and of the same nature as that at Stockholm. Small iron particles were extracted from it with the magnet. After repeating these researches, with the same results, in various parts of Sweden, the writer had the long sought for opportunity of continuing them in the Arctic regions. A floating sheet of ice, covered with snow, gave him indisputable proofs of the presence of iron, while the circumstances under which it was obtained precluded the possibility of its terrestrial origin. The substance on being fused gave a grayish residuum, consisting of fragments of northern plants and metallic iron. The inference drawn by the writer from the facts and experiments above detailed is, that the iron thus curiously found must be of cosmic origin.

——THE last contribution to science made by Gustav Rose before his death, a few months ago, records some interesting facts concerning the action of heat on the diamond and graphite. Rose found that by placing crystals of diamonds between carbon points *in vacuo*, and subjecting them to the action of a Siemens's dynamo-electric apparatus, the diamond became red-hot, and eventually flew to pieces, the surface having at the same time acquired a black crust, which had all the appearance and characteristics of graphite. Exposed to the temperature at which cast iron melts the diamond was found to undergo no change, but at the fusing point of wrought iron it became quite black and opaque, exhibiting a strong metallic lustre, and becoming in fact converted into a graphitic substance. But the most curious point in the behavior of the diamond is seen when the gem is heated in a muffle with access of air. Under these circumstances the faces of the diamond exhibit regular triangular depressions, reminding one of the markings common on many of the South African diamonds.

——IT has been proposed by Mr. John Newlands, in consequence of the sudden destruction of the two large ocean steamships, the Atlantic and City of Washington, that each large passenger ship should carry a small but powerful steamboat or launch, so that in foggy weather this launch could be sent on ahead some few hundred yards, being connected with the passenger ship by a flexible telegraphic cable provided with an electric battery, by means of which signals or messages might be continually transmitted from one to the other. The steam launch should also carry an electric or other strong light, and be provided with a powerful steam whistle. On meeting with ice or with vessels, or unexpectedly approaching the coast, it would be comparatively easy to stop the steam launch, and give warning in time to save the steamer from danger.

——IN a former number of the Review we presented a somewhat extended article upon the improvements effected by Mr. Elbridge Wheeler in the art of combining iron and steel, and in the art of manipulating such combinations—especially in the production of tubular masses of considerable size. The application of the invention to the production of railroad and street rails seems to be of sufficient importance to warrant special mention. The many costly experiments made within the past few years by railroad managers, in connection with the use of steel for rails, seems to have demonstrated that the best results, both in point of economy and safety, will be derived from a construction in which a practical and efficient combination of iron and steel has been effected—the presence of the iron giving the requisite strength, while the steel with its hardness will afford the most efficient wearing surface.

Fig. 1.

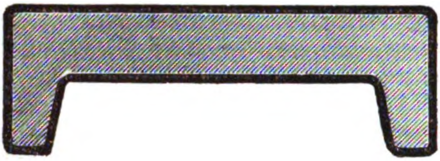
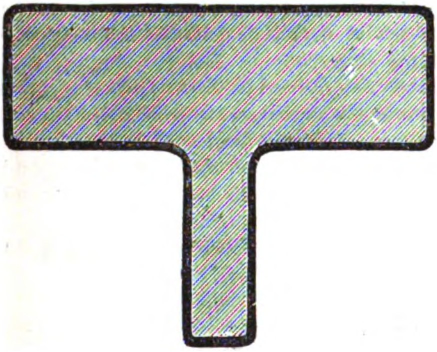
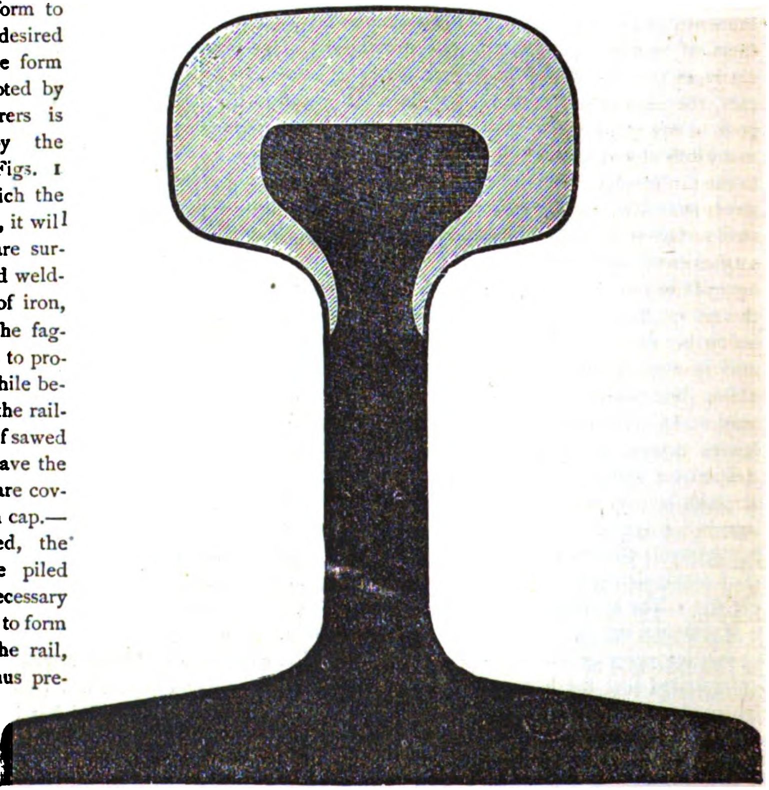


Fig. 2.





The processes which have been attempted to effect this desirable combination in practice, have been numerous, and upon many roads the so-called steel-capped rail is employed with more or less satisfactory results. In some of these constructions the steel head is confined in place by means of bolts or rivets; in another form, much more expensive to execute, the iron base and stem are rolled at one operation, the steel cap at another, and the two parts together at a third. Mr. Wheeler's simple and peculiar process of producing combination metal* is admirably adapted for the purpose here under discussion. In support of this assertion, the following presentation of the case is made.

To make the combination rail, the first step consists in producing from the ingot of steel, enclosed in its iron case, an iron-coated steel top-plate for the "rail-pile." Taking an ingot or other form of steel, it is reduced, as explained in our former article, at one heat, and by rolls to any required form to produce the desired rail-head. The form preferably adopted by the manufacturers is represented by the above cuts (Figs. 1 and 2), in which the steel top-plates, it will be observed, are surrounded by and welded to a shell of iron, which, as in the faggot, still serves to protect the steel while being heated in the rail-pile; the ends, if sawed off so as to leave the steel exposed, are covered by an iron cap.—Thus protected, the top plates are piled with the necessary amount of iron to form the body of the rail, and the pile thus prepared is heated. No injury, it is claimed, can result to the steel thus protected; its peculiar virtues being preserved intact, while, in addition, the fact that by protecting it in this manner, the steel may be heated to a semi-molten condition, enables the reduction into a rail to be effected with the same rolls, power, and speed as employed on iron. Yet another advantageous feature of the invention is the fact that a much "higher" or harder steel can be used than it has been possible hitherto to utilize.

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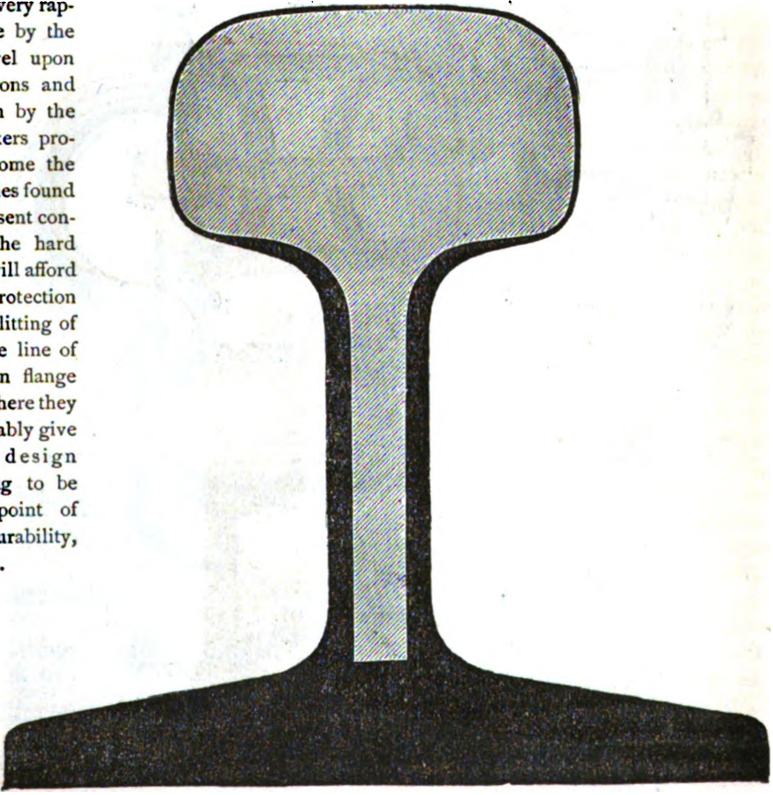
* See American Exchange & Review, vol. xxiii, page 388.

The forms of rail produced by the top-plates (Figs. 1 and 2), are shown respectively in Figs. 3 and 4, in both of which are combined the two important advantages of a weld with an added lock or dove-tail. In Fig. 3 the steel is carried so far under the head by the peculiar form of the top-plate (Fig. 1), that it completely locks the centrally-located iron; while in Fig. 4, which affords a solid steel-head rail, the lock is in the stem, the steel portion of which is carried down so as to have a bearing in the base, thus precluding any possibility of separation.

Amongst the incidental advantages not yet enumerated, it is claimed for these rails that the largely increased welding surfaces between the two metals insures a more efficient and reliable joint than has hitherto been attained in similar construction—an advantage which is heightened by the thin shell of iron, which, so proportioned in the top-plate as to be absorbed on the tread, gradually increases in thickness under the head, where it firmly holds the steel on the outside, and forms an additional lock to the iron of the stem.

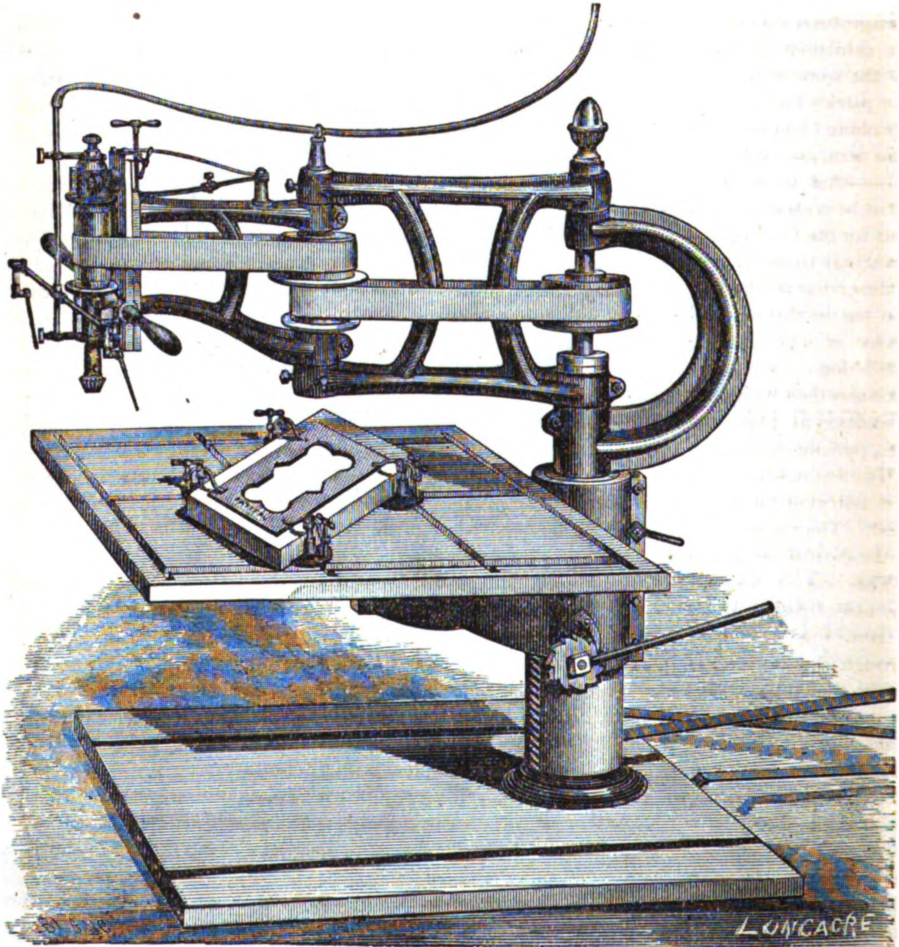
The proportion of steel to iron in rail Fig. 3, is about one-fourth; in that shown by Fig. 4, it is nearly one-half.

Fig. 4.



In street rails, which are subject to very rapid wear, more by the immense travel upon them of wagons and carriages than by the cars, the makers propose to overcome the many difficulties found to exist in present construction. The hard steel surface will afford sufficient protection against the splitting of the rail on the line of union between flange and tread—where they almost invariably give way. This design leaves nothing to be desired in point of strength, durability, and economy.

——The Gear stone ornamenting and surfacing machine is a new tool for the more expeditious manipulation of stone for architectural purposes, invented by A. S. Gear, of Boston. The design is to cheapen the cost of dressing and ornamenting building stone, thereby enlarging its use for architectural purposes. Of this machine we give an illustration. The cutting implement is the diamond; and the inventor claims that he has so materially reduced the cost of such work as to perform with facility the labor of 100 men with one of his machines. It is very simple in construction, the operating mechanism resembling very closely the human arm. It rests upon a heavy bed-plate of iron, to which it is strongly secured. At one end of this rectangular bed-plate rises a hollow column, upon which rests an upright shaft, to which the working mechanism is attached. A jointed arm projects at right-angles from this shaft, and to the extremity of this is attached a vertical spindle, carrying at its lower extremity the cutting tool. Above the lower bed-plate, directly below the cutting tool, is located a movable table, upon which is placed the stone to be dressed or ornamented. This upper bed-plate is adjusted—up or down, as may be required—by the aid of a ratchet-wheel and lever, within easy control of the operator. It is designed for sustaining light work, and when heavy work is to be executed upon the lower bed-plate, it can be turned entirely out of the way. A simple outline pattern, cut in wood by a jig-saw, is attached to



the stone to be dressed by means of clamps, and this the operator uses to form the design to be cut in the stone—the articulations of the working mechanism permitting him to follow the outline of the design, whether simple or complex, with the greatest facility and celerity. To afford greater convenience to the operator, two adjustable handles are attached to the spindles, by which the pattern may be followed with much ease. To surface off a rough stone, a special cutter is employed, without any pattern. To form a circular column, the mechanism is adjusted in a manner similar to that used for holding metal in a lathe. For ornamental work, both the stone and pattern are held down upon the table by adjustable clamps, and every adjustment has been designed with a view to permitting rapid change.

The machine is driven at high velocity, and the spindle holding the cutter may be run at almost any angle. The tools employed for cutting are of steel, studded on their lower surfaces with black diamonds, which have been so successfully used in rock drilling. The tools are said to show little if any wear, even after twelve months' service. The method of holding the diamond is original with the inventor, and is designed with a view of avoiding the breaking or loosening of the diamond by the concussion and strain. Every form of ornamental work which may be desired in stone-work, it is claimed, may be produced by this machine. It is the subject of several patents both in this country and in Europe; and through the diversity which it admits of in application, nearly every design heretofore produced in wood by machinery, may now, by its aid, be done in stone. While on exhibition in Philadelphia, this machine attracted considerable attention from those interested in the working of stone. Larger machines of different design are built by the company owning the patents for dressing stone only. One, weighing ten tons, was first exhibited at the Gear Stone Machine Company's works in Boston, October 21st, and was pronounced by mechanics and scientific men, who were present, a success.

——AMONG the most novel pieces of mechanical construction recently brought to public notice must be reckoned the machines invented by Mr. H. R. Heyl, Philadelphia, for making paper boxes, and for the first time publicly exhibited at a recent monthly meeting of the Franklin Institute. The machines in question are the result of years of patient labor and perseverance, and the inventor is deserving of all praise for having so completely and efficiently triumphed over many difficulties. He has in the past seven years built three machines for making paper boxes, the last and most perfect of which has but just been completed, and is the one referred to as having been placed on exhibition. As to the usefulness of machinery to produce paper boxes with greater rapidity and economy than by hand labor, little need be said, since a simple enumeration of the various branches of industry in which they are indispensable, affords superabundant evidence of their great utility—viz., perfumery, jewelry, hardware, trimmings, matches, and a host of other branches.

The first machine constructed by Mr. Heyl for this purpose was adapted to the automatic shaping, and fastening by paste, of the usual rectangular box, varying the style according to the materials used. The capacity of this machine is 2,000 boxes in ten hours—a capacity which is equivalent to the duty of ten of the most expert workmen employed during the same time.

The second machine has for its object the production of boxes for various purposes without the use of paste, the fastening of the edges of the paper being accomplished by delicate pieces of iron wire, measured and shaped by the machine into miniature staples, which are pressed through the material and clinched at the proper instant. The primary design of this second machine was the production, at rapid rate and cheaply, of match-boxes and other cheap receptacles for tacks, screws, and various small articles; and the substitution of wire fastenings for the paste, besides greatly increasing the *duty* of the machine, is quite a desideratum on other accounts. It is said by those familiar with the details of such trades, that the delay in drying the boxes when pasted, which often occurs in damp weather, frequently interferes with the shipment of large invoices of goods; in some cases of protracted damp weather, the paper boxes really mildew before they dry, and might ruin or seriously damage the goods packed in them. It was to obviate these obvious, but to others insuperable difficulties, that the inventor has produced the wire fastening machine we have alluded to. The work accomplished by it is not only neater and stronger than that done by hand, but the rate of production of one machine is that of seventy-five workmen.

The method of fastening the edges of the paper with wire staples is as follows: The wire is wound on a spool, from which the proper lengths are drawn by the machine for each box; the staples are formed and brought each to its place, at right-angles with the box material, and are made at the proper moment to puncture it, upon which they are, an instant later, firmly clinched on the opposite surface. The power of impact exerted at right-angles with an opposing surface, is here beautifully illustrated; and be it remembered that the entire production of the box is to be ascribed to the machine, every portion of the work being automatic. The machine sizes the slips of wrapper singly, and shapes them, and throws out a match-box complete—even to being touched with glue and sprinkled with sand—at the rate of 30,000 pieces per day of ten hours.

The third machine is simply a modified form of the one just described, in which its metallic fastenings and general movements are applied to the production of rectangular boxes of superior quality and of various sizes, applicable for safe package and display of articles of luxury, &c. The completion of these machines is a realization of the labor of seven years, and they are now busily plying their functions with perfect success.

The invention of the paper-box machine, by which the supply of articles indispensable to many of the small ware producers is vastly increased and cheapened, cannot fail speedily to result in the complete substitution of machine-labor for the hand-labor formerly universally employed for the purpose; while, from its perfect adaptation to the uses for which it is designed, and the mechanical ingenuity displayed in its conception and design, it is worthy of all praise.

——A GERMAN invention, recently patented, and which may be useful to draughtsmen and others, has for its object the rendering more or less transparent of paper used for writing or drawing either with ink, pencil, or crayon, and also to give the paper such a surface that such writing or drawing may be completely removed by washing without in any way injuring the paper. The object of making the paper translucent is, that when used in schools, the scholars can trace the copy, and thus become proficient in the formation of letters and outlines without the instruction usually necessary; and it may also be used in any place where tracings may be required, as by laying the paper over the object to be copied it can be plainly seen. Writing paper is employed by preference, its preparation consisting in first saturating it with benzine, and then immediately coating the paper with a suitable rapidly-drying varnish before the benzine can evaporate. The application of varnish is by preference made by plunging the paper in a bath of it, but it may be applied with either a brush or a sponge. The varnish is prepared of the following ingredients: Boiled bleached linseed oil, 20 pounds; lead shavings, 1 pound; oxide of zinc, 5 pounds; Venetian turpentine, ½ pound; mix and boil eight hours. After cooling, strain, and add white gum copal, 5 pounds, and gum sandarac, ½ pound. Thus prepared the paper will be found to possess all the requisites for use as stated above.

——THE approaching transit of Venus, which is just now engaging the attention of astronomers the world over, is receiving special consideration from American scientists. Prof. Newcomb, of the United States Naval observatory, has just returned to this country from a European tour of consultation with foreign astronomers upon this interesting subject, and announces that so far as astronomical measurements are concerned there can be little alteration in the plans already proposed. The chief modifications adopted consist in the methods for photographing the sun. The French will employ the method first proposed in America by Prof. Winlock, of Cambridge observatory; other observing parties will likewise employ the same method. A general agreement was made in behalf of the several governments to unite for the purpose of fixing the exact longitude of all stations reached by telegraph. So far as now definitely arranged, there will be forty-one stations occupied by observing parties, all equipped with the best instruments of precision which modern science and mechanical skill can produce. Of these stations the United States will occupy eight, England and France each six, Germany five, Russia fifteen, mostly in Siberia, and the private party of Lord Lindsay, a Scotch nobleman, one, upon an island off the coast of Madagascar.

——THE largest gun as yet constructed is the "Woolwich infant," of 35 tons weight, which fires a 700 pound shot with a charge of 110 pounds of powder. From an English contemporary we glean the information that the shot from this monster piece of ordnance could perforate the turret of the "Devastation" at any distance up to 500 yards. The armor-plating of the "Devastation" is 14 inches in thickness, but an additional 2 inches in thickness would make the vessel shot-proof against the largest gun in the world. The war department—so our authority states—has hitherto cautiously advanced from guns of 12 tons weight to 18, 25, and ultimately to 35 tons in weight; but the department is now said to be contemplating the construction of one of 60 tons weight, the powder charge for which will weigh 200 pounds, and it will throw a shot over a half ton in weight, which will be able to perforate a 20-inch turret.

MONETARY.

THE most notable sequences of the September panic were a rapid partial recovery in prices of values first affected, and a subsequent wearing down of prices in general; the latter, however, not altogether of a character to show that a permanent breach had been made in the expansion which has ruled for the last ten years, though accompanied with instances of reduction in wages rates, which is, as a rule, a signal for the common marking down of prices. To previous currency limitations, the panic adding an embargo on currency circulation, settlement of debts by parties not having immediate available resources was impeded, and bankruptcies have followed in manufacturing and mercantile, as well as banking circles. The trouble largely removes the railroad companies from the markets as borrowers, and closes up the industries dependent upon railway extension and enlarged equipment. In so far as the convulsion was revolutionary, it was in the direction of temporary resumption of specie payments. Currency has been at a premium over certified bank checks—approaching, in its maximum, 4 per cent.; imports have diminished, and an influx of gold has commenced—*i. e.*, more gold and less use for it; but the less the difference between gold and currency, the less the risk of speculation, and the greater the incentive to it; and the position of the federal treasury indicates an increase in United States legal-tender (now $360,000,000) to $400,000,000—especially as it is semi-officially asserted that, in event of deficient revenue, congress will not be called upon to levy fresh taxes.

Owing to the season of the year, the interior has felt comparatively less of the currency stringency than the seaboard, and the Western banks lead off in the resumption of currency payments.

——Sales of Stocks, etc., at New York.

	Sept. 29.	Oct. 6.	Oct. 13.	Oct. 20.
U. S. 6's, coupon, 1881	....	114½	114⅛	111¼
" 5-20's, coupon, 1862	....	108½	106⅛	105
" 5-20's, coupon, 1864	....	109½	106½	106½
" 5-20's, coupon, 1865, m & n	....	111	107¼	107
" 5-20's, coupon, 1865, j & jy	....	113⅝	110¼	109¼
" 5-20's, coupon, 1867	....	114¼	111½	111¼
" 5-20's, coupon, 1868	....	114½	110½	111¼
" 10-40's, coupon,	....	109½	105	105½
Pacific 6's, currency	....	....	....	....
Tennessee 6's	....	....	....	....
" 6's, new	....	....	....	....
North Carolina 6's	....	....	....	....
" 6's, new	....	....	....	....
Missouri 6's	....	....	....	....
N. Y. Central and Hudson R. con	92	94⅜	88¼	88¼
Harlem	111	117	109½	109
Erie	51	49⅜	46	45⅜
Lake Shore and Michigan Southern	75	77⅜	65⅜	66¼
Wabash	44½	48⅜	42¼	43
Cleveland and Pittsburgh	....	82	78½	79
Northwestern	43	45½	40	38¼
" preferred	67½	....	....	....
Rock Island	91½	96	88¼	90¼
Fort Wayne	....	....	86½	8[illegible]½
Milwaukee and St. Paul	34½	34⅞	29	30½
" " preferred	....	....	....	....
Ohio and Mississippi	30	29⅞	26¼	26⅛
New Jersey Central	....	94¼	90	90

	Sept. 29.	Oct. 6.	Oct. 13.	Oct. 20.
Western Union Telegraph	68	71¼	58	56⅞
Pacific Mail	34½	36¼	31⅝	32½
Union Pacific	20	20⅞	18¾	19
Adams Express	....	85	81	82
Wells, Fargo & Co. Express	....	63	59	61
American Merchants Union Express	....	57½	54	53½
United States Express	....	58¾	53	54½
Rate for Money	⅛@¼	1/32@1/16	1/16@3/16	7@

Sales of Stocks, etc., at Philadelphia.

Gold	114½	116½	108¼	108⅜
Sterling Exchange	....	....	....	115½
Paris Exchange	....	....	....	4.92
Lehigh Valley Railroad	....	58	57	54
" " 6's	....	....	....	....
" " 7's, reg	....	....	....	95
Lehigh Navigation	22	28	26¼	23
" " 6's, 1884	90	93	84	....
" " 6's, g ln	....	85¾	84½	....
" " 6's, reg	....	....	....	....
City 6's, no tax	....	100⅜	101	100½
" tax	97¾	97	96	....
Pennsylvania Railroad	43½	49½	48¼	45
" " allot	....	....	....	....
" " 6's, 1 m	....	....	....	....
" " 6's, 2 m	....	....	95	95
Pennsylvania 6's, first series	....	....	....	....
" 6's, second series	101¾	101¾	102¼	102½
" 6's, third series	....	....	105	104
Reading Railroad	46	52	51¼	48⅞
" " 6's, mt	....	....	....	....
" " 7's, reg	92	96	....	97¼
Catawissa Railroad	....	....	12¾	12
" " preferred	35	39½	38¼	37
North Pennsylvania Railroad	....	....	49	....
" " " 6's, mt	90	95	96	98
" " " 7's, mt	98	96	....	98
" " " 10's, chat	....	....	....	....
United N. J. Companies	114	116¼	114½	112
Camden and Amboy 6's, mt	....	....	....	96
" " 6's, 1883	....	....	....	88
" " 6's, 1889	93	93½	96½	....
West Jersey Railroad 6's	....	....	....	....
" " 7's	....	....	100	....
Philadelphia and Erie	13	....	16	15
" " 6's	....	....	....	....
Allegheny County 5's, coupon	....	....	....	....
Schuylkill Navigation	....	....	....	....
" " preferred	....	....	....	10
" " 6's, 1882	....	....	70	....
Morris Canal	....	....	....	....
" preferred	....	....	....	....
" 6's, 1882	....	....	....	85
Little Schuylkill Railroad	....	....	45	42¼
Oil Creek and Allegheny Railroad	16	18¾	18½	15
" " " 7's	....	....	....	58
Philada., Germ. and Nor. Railroad	....	....	83	83
Minehill Railroad	....	50	....	....
Elmira and Williamsport, preferred	....	....	....	....
" " 7's	....	....	93	93
" " 5's	....	....	....	....
Northern Central	....	....	....	....
Rate for Money	....	12@18	12@15	10@12

NOTING AND COMMENTING.

FRANCE has resembled a suppressed volcano during the entire month—even more than usually—and, although no outbreak has occurred, there are evidences that one may be expected at any moment. The coalition between the rival monarchists, once thought broken, seems to have been revived, and at this time to be stronger than ever. The Count de Chambord has appeared before his countrymen with several manifestoes, intended to disarm the fears of his opponents and foreign powers. These manifestoes show that the Bourbon has "forgotten and learned" during the past decade, or perhaps that he has been taking lessons from some astute politician in the noble art of soliciting suffrage. He promises that no extreme reactionist measures will be attempted; that no war with Italy in the pope's behalf is intended; and that the national standard shall remain the tri-color. His friends and supporters do not conceal their exultation at the prospect, and say that the monarchy is already virtually re-established. The opponents of the restoration of the Bourbons, who include imperialists, republicans, and communists, of every shade of political opinion, on the other hand have evidently been apprehensive that the present assembly contains a monarchy in embryo; but their fears have caused them to be extremely energetic and watchful, and also to come together in a spirit of compromise—which last is certainly new to political parties in France. The extreme radicals, in their disgust at the prospect, promise to be guided by their more moderate associates; and, although this is only a promise, still it is a step in advance. Elections to fill vacancies in the assembly took place, October 12th, in four departments, resulting in the choice of republicans in each. These elections have done much to reanimate the republicans, and Thiers, now their acknowledged leader, is very confident of the final establishment of a republic, in which view most of his subordinates concur. If the overthrow of the monarchial party would have this effect, perhaps outside lookers-on might also join in the belief so freely expressed; but, when one reflects upon the nature of the opposition to Bourbon rule, doubts arise as to the precise form of government or anarchy which will take its place. —Marshal Bazaine has finally been arraigned before a court-martial, which commenced its sitting at Versailles, in the palace of the Trianon, and has continued its session every secular day since. Only a portion of the testimony of the prosecution is yet in, and the trial bids fair to be a long one. The case, of course, now looks bad for the marshal, but no conjecture can be hazarded as to his guilt or innocence until the defence shall have been put forth.

An improvement in the position of the government in Spain is manifest, and the prospect of the establishment of law and order is of a more cheering character. In spite of the protests of the neutral powers, the intransigentes commenced the bombardment of Alicante, September 27th, at 5 o'clock in the morning, and continued the pastime for seven hours, doing considerable damage, but were, at the end of that time, driven off, with some loss, and the vessels returned to Cartagena. October 12th, the intransigente fleet sailed out of the harbor of Cartagena and gave battle to the government vessels, and, after a fight of two hours' duration, were again driven back into the harbor in a damaged condition. Subsequently, Admiral Lobo withdrew the government vessels from before Cartagena, and proceeded with them to Gibralter for coal and repairs, without consulting the government. For this extraordinary movement he has been deprived of his command, and a court-martial ordered to investigate his action. The minister of marine took command of the government fleet in person, and, after some days of unaccountable inactivity, sailed again for Cartagena. Meanwhile, the insurgent fleet, after indulging in either a fight or careless seamanship in Cartagena harbor, which resulted in sinking one frigate—the Fernando el Catalico—with nearly all on board, sailed away, the commander giving out that they were going in search of the government vessels; but, at last advices, they were in the neighborhood of Valencia capturing Spanish merchantmen. The siege of Cartagena by the government forces continues, and indications of demoralization among the insurgents there and the Carlists in the northern provinces multiply daily. The government has succeeded in getting the promise of a loan from the Bank of France, and the Duc de Broglie, in reply to questions propounded to him, stated that he did not intend to permit the arming of Carlists on French territory. Moral support also has not been lacking. The ministers from Guatemala and Costa Rica have arrived at Madrid with instructions to recognize the republic.

Victor Emanuel, not feeling so secure in his Italian possessions since the prospective return of the old monarchial party in France to power, has been on a friendly visit to the courts of Vienna and Berlin. At least, his recent visit to those capitols is credited with great political significance, and rumors are rife among the wise ones that he has returned, feeling assured that should France attempt to reëstablish the temporal power of the pope, he can rely upon the active assistance of both Austria and Prussia.—The general of the Society of Jesus was officially notified by the government, October 20th, that the order must im- immediately vacate the premises then occupied by it in Rome.

The bad feeling between Germany and the pope continues. The emperor has recognized the old Catholic bishop, Reinkins, as the true bishop, much to the chagrin of his infallibility, and the bishop in turn has been invested with the usual formula, excepting the reservation of first allegiance to the pope. The late correspondence between the emperor and pope has also been published. It seems to amount to nothing more than a protest by the pope against the course of the emperor as tending to weaken the emperor's own authority. The emperor replied, suggesting that the pope was laboring under a misapprehension as to the facts, and charges that the German priests were engaged in attemping to undermine his authority. A change in the German cabinet is rumored, and it is thought likely that Prince Bismarck will resume his position as president of the ministry, in place of Von Roon.

——There is an evident tendency towards centralization in every department and among all classes, and a growing distrust of local authorities in everything but politics, which is not an encouraging sign to those who desire that the system of self-government established in this country should last. The latest development in this direction is the proposition to establish a national sanitary bureau in connection with the interior department. The ravages of the cholera and yellow fever have given the question of sanitary regulations undue prominence, and the allegation is made that local sanitary boards are too restricted in their authority to successfully combat such epidemics, and straightway a very respectable class of people turn to the central government for relief. The American Public Health Association, soon to meet in New York, is understood to be full of the subject, and will come together and discuss the question in all its bearings. The fear is expressed, on the part of those who advocate the scheme, that unless great care is exercised the new bureau will become a political machine. We confess to a like suspicion, and we are decidedly of the opinion that without more care than is likely to be exercised it will be impossible to prevent either the proposed national sanitary bureau, or the proposed post-office savings banks, or any of such projects, from becoming political machines, and very dirty ones at that.

——Mr. Sumner's proposed Civil Rights bill seems to have been anticipated in Iowa, and perhaps by the whole country, and if so, the Republican party have "builded better than they knew." The case arose from the denial by a Mississippi River packet company of equal rights to the plaintiff, an educated and respectable colored woman, as passenger on the defendant's boat. She was not allowed a seat at the table with the other passengers, and was ejected from the cabin. The court held that a rule or custom of a carrier of passengers must be reasonable; that the custom of obliging colored people to eat in the pantry or on the guards of the steamer was decidedly unreasonable, and could not be enforced; and that any rule, based, as this evidently was, upon color or race, could not be maintained.

——The survivors of the Polaris expedition have reached this country and been examined by the secretary of the navy. A new lot of sensational stories in regard to the death of Capt. Hall have been set afloat only to be swamped by the secretary's report. The Tigress has returned from her unsuccessful search, and the only result of the Polaris expedition seems to be a round sum expended, and some unimportant discoveries.

——The sixth annual session of the National board of trade has commenced at Chicago. Judging from the official programme the convention has work enough to do to necessitate its remaining in session for the remainder of the year. It proposes to take cognizance of the departments of commerce and trade, the reform of the currency, national banking, transportation interests and facilities, American shipping interests, &c., &c. Congress is to be asked to pass all manner of laws; to establish departments of trade and commerce; to permit foreign-built vessels to be registered; to reorganize the Indian territory; to amend or repeal the Bankrupt act; to enact a uniform law to govern the exemption of property from executions; and various other laws too numerous to mention. Some of these recommendations are very proper, and some are of very doubtful utility, and congress will have to move much faster than it is wont to do if it considers a tithe of these improvements at a single session.

——A news correspondent says the city of Dublin is not near so dirty as it was, and never so few houses to let; and within a few years rents have risen at the south side from 25 to 30 per cent., and even shopkeepers declare that the times are good and the country is prospering. The number of hackney cars (outside cars) licensed in Dublin in 1861 was 1,450; number of cabs, 774; total, 2,224. The number of cars in 1871 was 1,400; cabs, 1,070; total, 2,470. A great many of the smaller class of gentry, and nearly all ladies who have property in the country, have come to reside in Dublin or the suburbs, partly for the education of their children and for the sake of society, and partly to avoid any unpleasant collisions with their tenants. Most of the land being turned to grazing, in consequence of the enormous demand or butcher's meat, there is little or no labor to superintend.

——The constitutional convention of Pennsylvania has attached an article to its proposed instrument, requiring that the legislature shall define as an offence "any corrupt solicitations of members of the general assembly or any public officers of the State for or against the passage or approval of any law." There are too many laws on the statute books already, and the respect due to all law is necessarily weakened at every accession to the number not warranted by absolute public utility—the best test of the righteousness of any enactment. If the legislature desires to inculcate a becoming reverence to its decrees, it must be careful that its ordinances are at least such as will not move the respectable portion of the community to condemn both good and bad. A standard of correct legislation will be found the best safeguard against all corruption on the part of the solicitor or solicited.

——Boston, following the example of the other large American cities, is absorbing the outlying suburbs. At an election held in October the people of the respective towns of Boston, Charlestown, West Roxbury, and Brighton voted by handsome majorities for annexation. The addition to the population of Boston by the annexation of those towns is about 50,000, making the population now about 300,000. Boston obtains two great advantages by this consolidation; an unlimited supply of good water and a valuable harbor improvement, as it now has control of both banks of the Charles river. Brookline alone refused annexation by a decided vote, and now presents the spectacle of an independent borough, completely surrounded by a city.

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THE INTERNATIONAL COMMUNES.

IN considering the social and political problem of international communism, which is forcing itself on the notice of the present age, it will be well to search at once for the foundation, and see whether the advocates of the doctrine have any firm rock on which to build. It will be necessary to definitely fix what constitutes property, and we shall then be better able to understand its relation to individuals.

Evidently, the first man and woman who awoke to consciousness on the earth possessed nothing, but the fruits found spontaneously growing, and the water of rivers, were ample sustenance, which could be increased and varied by the appropriation of animals already created. Supposing the climate such that no clothing was required, and the descendants of the said pair satisfied with existence merely, like other animals, they would then have, per force, formed a true communism—enjoying freely this commonness of things. There was here no room for envy or jealousy to arise, because no special values or chattels were defined; and if some individuals were more gluttonous than others, the provision was ample to supply their wants, which comprehended only the requirements of passive life. The nearest approach to such simplicity we can now see is, for a few of the earlier years of the children in a very poor family, in a torrid climate, where, careless of the future, and with an ample supply of natural food, they live like the birds and the beasts on the bounties of Nature. It is necessary to admit that, in the cases supposed, which seem to be the purest communism imaginable, there is no distinction whatever between man and other animals; but, as soon as labor commences, the scene changes, and the second mode of acquiring property comes into action. To obtain clothing, the wool of sheep is sheared or plucked, washed—

possibly dyed—spun, and woven; afterwards, cotton, and other fibres in the same manner. With clothing comes the love of adornment, and also self-respect, which demands certain comforts—all requiring labor to obtain the coveted articles; implements of stone and iron become needful for defence and household purposes, and with the gradual formation of society, interchange of labor, products, and the arts are developed. He who has tamed no flocks or herds, rudely tills the earth, and barters surplus grain and fruits for sheep, cattle, ornaments, or such comforts as are invented, and the exercise of labor continually creates new wants.

Here, then, undeniably, is the basis of all *personal property:* it is acquired by labor, and can be transmitted to others by gift; just as at the present time, labor of body or mind produces competence or wealth, which can be inherited by another. As for *real estate*—even here, what man does he has—the only first title to the ground could be occupancy, and power to hold and defend against other parties, including naturally an additional tenure, by the deposit, as it were, of labor-property in the ground by tilling it, planting trees, building houses, and placing other improvements. As soon as communities commenced to exist for protection from the attacks of animals or men, the right of acquired occupancy, with subsequent improvements, was acknowledged, and in time duly protected by law—the security of the *meum* being the security of the *teum*—so that a man could safely bequeath (give) his real estate as property to descendants.

This brings up the question why the descent should be to the children of a family, rather than to all of the community in which the decedent dwelt. There is a brief answer to this: first, it asks to sink the individuality in which property begins into the commonality in which it is lost, and, second, what one has acquired by labor of body or mind is his, and, *as* his, descends to whomsoever he may designate; the fitness of the designation consists in what is his going to *his*—what man acquires being as much his own as his hair or his hands.

This being settled, we can begin to understand what might cause discord and dissatisfaction in society. One individual has more industry, or better judgment in affairs than his neighbor, and naturally acquires more property; or war ensues, and the strongest obtain the most booty, which, though not at first the property of the person obtaining it, becomes established as such among his adherents as soon as it is firmly held. Had all men equal industry, prowess, and mental power, envy and dissatisfaction might in such case be banished, and harmony reign in the supposed community; but this is not human society. Created with desires other than those of mere animals, and with diverse powers of body and mind, men acquire real and personal property in different degrees, in simply fulfilling the law of their own being as individually modified. This being admitted, the question arises: Why should those who have obtained more than the average amount, distribute the surplus to a community?

In the accounts found in the earliest histories of society, each family held property separately, and it descended to the children direct. As towns and cities were founded, bounds of real estate were established, and laws enacted to protect each one in his possessions. In Egypt, the most ancient of historical nations, appears to have existed the principles and many of the laws given by

Moses—he evidently founding on Egyptian usage his strict punishment for theft, and the removal of boundary stones and marks; and whether the great Jewish lawgiver, "learned in all the learning of the Egyptians," originated or adopted, he certainly gave legal formulation to the continuance of customs existing long anterior to the Jews, and in this followed the true founding of all law: property was a usage before it was a law, and hence property is no mere creation of an arbitrary legal system.*

The fact that power has forcibly despoiled men, cannot enter into the question, for we are to consider natural powers and gifts, not assumptions of power. To attempt to purge out of society the result of past plunders, national or individual, would be to try to reconstruct and modify the past within the domain of the present—to seek out an impossible equity by the ways and means of unparalleled plunder; and Proudhon logically sets aside any such irrelevancy of inquiry by his fundamental proposition: "all property is robbery."

It is pertinent to examine whether any societies of real communists, ancient or modern, have obtained success or permanency. The enforced equality of Sparta has long since departed—the community of goods among early Christians was intended to be temporary, while Christianity has gone on towards full development on a different basis—and all the various schemes of "reformers" for hundreds of years, up to this time, embodying the idea of communism, have died out, one by one, after brief existence.† The ideal republics of Plato and Sir Thomas More, which once were strong in moral effect, have now no power to form opinion; the societies founded by Owen, and many others, are also all of the past. Fourier's family organizations are also extinct.

In the United States, at present, the Shakers, and two or three other societies, are the only ones retaining the practice, but they are so inconsiderable in numbers that they are only like the aggregation of a few families; and their very character demonstrates stability, even in this small ratio, to be but exceptional. It may here be objected that monasteries and nunneries have had long existence as communities, but this is not a valid argument. They are not general; they represent only a few religious sects (Mohammedan, Roman Catholic, and Greek); and if left to themselves, without outside support from the sects to which they belong, could not continue to exist. The question of possibility includes that of internal subsistence and permanence. No one will deny that, if a certain number of persons or families choose thus to bind themselves to a strict community of associated property, it is lawful for them to do so. It is not to such enterprises that we now refer, but to the doctrine as applied to nations, and to those who, not agreeing to its demands, would be by force despoiled of the greater part of their possessions.

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* Robespierre endeavored to introduce the following clause into the constitution of France at the commencement of the Revolution in 1793: "Property is the right which each citizen has to enjoy and dispose of the portion of goods guaranted to him by the law." Of course, had this been adopted, the legislative assembly would have made a law dividing the property of the wealthy.

† Certain sects of philosophers, at various ages of the world—among others, the Pythagoreans, of Greece, and the sect of Essenes, among the Jews—practiced community of goods, &c.; but, in all these cases, the numbers were few and the duration very limited.

This seems naturally to lead us to consider the rise and probability of success of communism, (or the Society of Internationalists, so called,) which society has existed in Europe, under various names, for centuries, and in its later and worse development, for more than a hundred years. During the past eighty years its adherents have committed crimes and proclaimed doctrines, causing them to be viewed as the most dangerous of men, and shocking to all sense of justice, virtue, and duty.

M. Augustine Thierry (*Récit des temps Mérovingiens*) states that the societies of the commune are derived from the ancient Scandinavian guild (*ghild*), which was an association or brotherhood at common cost, and bound by an oath, for mutual protection in tumultuous times, and existing as early as the sixth century. These guilds gradually extended all over Europe, but especially in Holland, Germany, Austria, and Italy—last, but not least, in France—and took the form of trade societies (guilds), some of which became very powerful and ambitious, and finally were suppressed.

M. Bréquigny, in the eleventh volume of *Recueil des Ordonnances*, fixes the epoch of the revival of the commune in France during the twelfth century, under Louis VI. These were leagues of the *bourgeoise*, to resist the aggressions of the powerful and haughty nobles. Of these societies, the largest was that of the peasants of Normandy, whose influence was felt throughout the whole of France. All these societies, after several hundred years' existence, fell into disuse, and the revival of the precursors of the present exaggerated form may be said to date from the work of Brissot—*Recherches philosophiques sur le droit de propriété et le vol*—Chartres, A.D. 1780, followed by others, foremost among which was Babeuf, who published *La Republique des 'Egaux*, *Le Tribun du Peuple*, and *Manifeste des 'Egaux*. The culmination of the doctrines such as these, inculcated in the first French revolution, is well known, but even the human fiends of those days could not stand Babeuf, and he perished by his own hand, on being condemned to the scaffold, May 26, 1796. The actual date of establishment in France of the commune, as now existing, was in 1838 and 1839, and from that centre the societies rapidly spread to Germany, Spain, and all parts of Europe. It had a strong influence in causing the revolution of 1848, and the horrors enacted by the commune in Paris in 1871 are still fresh in remembrance. The present societies of the commune in Europe date the commencement of their *vigor* soon after the publication, by M. Louis Blanc, of The Organization of Labor, in 1840. This expression, from having been a long time in the mouths of socialist philosophers, now became a popular cry, and his views were taken as a programme of positive, practical, and immediate amelioration. We have, since that time, seen what important results have come from the organization of labor in the United States.

The originators of the commune in the last century undoubtedly drew many of their ideas from the philosophical romance, Utopia, written in Latin, A.D. 1519, by Sir Thomas More, chancellor of England, which work it is difficult to class whether as a satire or a diversion.* Sir Thomas was, in his turn, largely indebted to the Republic, a long dialogue of Plato; so that it appears, if there be any odium in this unsavory and unprofitable doctrine, the ancient philosopher must bear the stigma. Plato says in his book of Laws: "Wheresoever it may yet be realized, property must and should be common among citizens; and the greatest care should be taken to withdraw even the name of property from the intercourse of life." The following, from the first book of Utopia, shows that, in the main points, the two works agree: "When I balance all these things in my thoughts, I grow more favorable to Plato, and do not wonder that he resolved not to make any laws for such as would not submit to a community of all things."

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* Several other celebrated works of similar description were written: Harrington's "Oceana," Campanella's "City of the Sun," Jean Bodin's "Republic," and Morelly's "*Code de la Nature.*"

It is not strange that, with so great an influx of population as the United States have received, and are receiving, from the old world, this element of agitation should be added to American society. To inform ourselves of the real basis of European communes—or Internationales, as lately called—and to see what is to be derived from them, let us examine their creed. The following article of belief is translated from *Douze lettres d'un communiste à un reformiste*, by Cabet, who also wrote *Voyage en Icarie*, Paris, 1845:—

"The commune is an association of fraternity, equality, and unity.

"*Fraternal:* Because, in all times and countries, philosophers have considered the human race as one family of brothers.

"*Equal:* That is to say, based on equality. By this the commune means rights and duties, privileges and charges.

"*United:* That is to say, based on uniformity in all things—society, education, property, and employments; no more titles, no more social distinctions, no more castes; the unity of a nation of citizens—of workmen.

"*Education:* To be one and the same for all; elementary until 17 or 18 years of age—embracing the principles of all the sciences, of all arts, and of all trades; at this age a trade to be chosen.

"*Unity in Property:* The lands form but one undivided domain—social, national, common—though cultivated by the government, with all the national power, with all the citizens as agriculturalists and laborers, for the general interest. The products are gathered into vast storehouses, and the government attends to the management or production of everything needed for subsistence, clothing, lodging, and furniture. Suppose, then, that it distributes equally to all, for a common or separate enjoyment, what advantages would arise? No more enclosures, no more walls, no more imperfect cultivation, no more bad engineering, not an inch of uncultivated ground, no more inquietude about means of living, or care for the future—no more discord, no more hatred, no more war!"

In the promulgation of this doctrine, some desired to preserve the family relation, but others, by rigorous deduction of reasoning, found it opposed to the spirit of their system. We abolish property, they said, because we desire equality, but do we not openly violate this fundamental principle of our system by leaving children with their parents? Children, a source of work, production, and wealth, and consequently a source of inequality! Babeuf said, in his *Manifeste des 'Egaux*, April, 1796: "Perish all the arts, if need be, so that we retain real equality." He also taught: "There should be no grand centres of population; few, or no towns;

no palaces; houses to be commodious, but uniform; clothing of forms and colors to suit different ages and employments, but otherwise uniform."

Here is the sentimental creed of communism; but while it reads better than the savagery of communistic practices, it is an effort against Nature, and as such must prove futile in constructive work. Were it to succeed, there could be no commerce, no science, no arts, &c.; for all these require the spirit of emulation and competition, with large concentrated, not distributed, means. And yet such ideas have occupied some of the finest minds of Europe, and perverted the efforts of millions. It is working in America, in the form of a growing dissatisfaction among operatives, and an intense desire to wield a power regulating the establishments in which they are employed, to the destruction of the needful discipline and the requisite administrative efficiency of the business as such.

CLIMATIC CHANGES IN GEOLOGICAL TIME.

THAT our earth in the geological past possessed a climate quite different from what it now enjoys, and that this climate passed through very great changes before the present era, the fossil contents of the rocks of the various formations abundantly prove. The presence in high polar latitudes of tropical or sub-tropical species witnesses the prevalence in these latitudes of a tropical or sub-tropical climate during the time the species lived on the land or peopled the waters.

The value of this kind of testimony is unquestionable—knowing the conditions requisite for the vigorous growth of any species of animal or plant—the occurrence of the remains of that animal or plant in the rocks of any given age, proves the conditions to have been fulfilled. The presence in any part of the earth of a bed of limestone formed of molluscan remains, proves the previous existence of a large body of water, whose temperature, degree of saltness, depth, and other peculiarities, enabled it to sustain that particular species of mollusks. Deposits of coal in any locality necessitate the previous existence in that locality of those climatic conditions of temperature, moisture and light that would permit of the dense growth of the plants from which the coal was derived.

During the earlier geological ages we are able to prove, through testimony of this nature, that a very warm tropical or sub-tropical climate extended probably from the equator to the poles, certainly to very high latitudes; that no decided difference existed between the temperature of tropical and polar regions; the ages were characterized by uniformity of climate; the regular decrease of the temperature with the latitude had apparently no existence. Moreover, as the ages rolled on, this equability of climate continued, at least to a great extent, until near historic time. At no time during the early ages were the climatic contrasts as strong and decided as they now are. This period of equable tropical climate was followed by an intense cold over the greater portion of our Northern continents; and then, after a few fluctuations, our present climate was ushered in.

We purpose to review very briefly the testimony on which these assumed climatic changes are based, and then to show the physical grounds by which their existence can be explained. We will at first confine ourselves to the widely extended tropical climate which was characteristic of our earth's early history. What is the nature of the proof of a very great heat on our earth at this time of its existence? Confining ourselves to the North American continent, we discover in the thick deposits of limestone of the lower Silurian formations, which occur in the Arctic regions, a proof of warm tropical seas, for the rock is entirely of animal origin, and animal growth must necessarily have been very abundant to have produced such large deposits. In a somewhat later formation extensive coral reefs occur as far north as latitude 76°. Moreover, these corals belonged to species that never occur in waters whose mean annual temperature falls below 66° or 68° F. Hence the Arctic must then have been a reef-growing sea, with a temperature similar to that now found only in regions within or bordering on the tropics.

But the strongest evidence of the former prevalence of tropical climate in high northern latitudes is that given by the Arctic coal fields. Over the greater part of Melville and Bathurst islands, Banks Land, and other portions of Arctic North America, are extensive coal fields that differ apparently in no respect, either in the mode of their formation or in the plants from which they were derived, from the deposits that occur in the United States or in other localities. Now, since coal is the result of the decomposition of vegetable matter taking place under water during the time of its formation, low, flat, marshy lands must have existed, and have enjoyed such climatic conditions, as would enable them to sustain the very vigorous and luxuriant vegetation necessary to produce the coal. A study of the carboniferous flora shows the predominance of an immense number of ferns, both tree-like and smaller. Next in abundance come the Lepidodendra, Sigillariæ, Calamites, and Stigmariæ. But all the ferns require an abundance of moisture and a warm climate that is subject to no considerable fluctuations, while the other species, also, are those that only flourish in warm, equable regions. The plants, then, form a safe criterion from which to infer the climate; and since the same, or nearly the same, flora occurs in the Arctic coal beds as is found in those of Pennsylvania, or in those still further south, we are led to infer the prevalence of a climate in the Arctic region which differed in no essential respect from that existing in the middle of the North American continent.

It cannot be fairly objected to these considerations that, whatever be the origin of the other coal beds, those in the Arctic regions have arisen from the transportation of the vegetable materials by rivers from regions considerably to the south of their present location; for, in such a case, the fossil leaves, fronds, &c., would undoubtedly show by their broken, worn appearance, the influence of such floating. On the contrary, the preservation of the most delicate portions of the vegetation is a characteristic feature of the carboniferous fossils.

Testimony of a different kind, though scarcely less conclusive, comes from the study of remains in the extreme northern portion of the Arctic continent, which, though it does not show the existence of a climate at all tropical, or even subtropical, at least proves it to have been less severe than that which now prevails. It has for a long time been known that over various portions of the Siberian lowlands bordering on or near the Arctic ocean, and stretching from the Ural mountains to the Pacific ocean, immense quantities of the bones of a species of elephant are found. As early as 1772 Pallas obtained from the banks of a tributary of the Lena, in latitude 64° north, from the frozen soil of the river's bank, the remains of a large species of rhinoceros, and mentions the prevalence throughout the region of great numbers of mammoth remains. The existence of these remains led to no little speculation concerning the nature of the animals to which they belonged, and many strange explanations were suggested to account for their presence in such high northern latitudes. On the supposition that the habits of the animal were the same as those which are at present found in various portions of Africa and Asia, it was at first supposed that the climate could never have permitted them to live in such cold regions, and huge floods were assumed to account for their transportation from southern regions. In 1803 a remarkable discovery was made, which tended to throw no little light on the matter. Near the mouth of the river Lena, in latitude 70° north, from a portion of the bank where the river had cut a deep channel through the soft, alluvial plain, the perfect remains of a huge mammoth was obtained. The body was nine feet high and sixteen feet long, excluding the curved tusks. The most remarkable thing connected with the discovery was the complete preservation of the flesh of the animal, which was so well kept as to furnish food for large numbers of bears and wolves. The climate of northern Siberia is so severe that the short summers are only able to thaw the soil for a few feet from the surface, so that the remains of any animal once buried in the ground would remain forever encased in solid ice. Since this discovery others have been found, though in a less remarkable state of preservation, and indeed the number of bones in many places is so great as to form mounds of no inconsiderable size. The tusks are well preserved, and the importation of the ivory so obtained has been found to be very profitable.

The mammoth from the mouth of the Lena was found well protected by several hairy coverings that would enable it to live comfortably in a moderately rigorous climate. The occurrence of its remains in Siberia would not, therefore, necessitate the climate of that country to have at all approached that required by the hairless elephants of Asia or Africa. But that a cold very much less severe than that which now prevails in Siberia existed when the mammoth roamed over its plains is clear, since even could the animal have resisted the present intense cold, which is very improbable, it could not have found in the scanty vegetation now covering the great northern plain, sufficient food to sustain it in common with the immense numbers of its fellows.

The strata containing the remains of the Siberian mammoths are all of recent origin, so that their presence does not necessitate a belief that a temperate or cold temperate climate prevailed here, while America enjoyed a tropical or subtropical one. Indeed, similar changes were in progress in the North American continent, which were to usher in a severe climatic change that wrapped the entire Northern hemisphere in fields of snow and ice, reaching far down into our present warm temperate zones. It is the evidences of this latter change that we will now consider.

During the formations of a period almost immediately before the introduction of man on the earth, the following peculiarities are observed in certain portions of the land. Here and there are found large accumulations of gravel, sand, and stones, arranged without any order of stratification. The material does not present at all the appearance of having been transported or distributed by rivers. In North America it occurs in Canada, and through the United States as far south as the lower portion of Pennsylvania, Ohio, and Iowa. Associated with the gravel and stones are huge boulders, some of which are over 40,000 cubic feet in bulk. This material is found alike in low and elevated country, occurring on Mount Washington, 6,000 feet above the sea level, and several thousand feet high in other mountains. That the material is not of marine origin seems to be proved by the entire absence of shells or other marine remains. It is finest near the southern part of the region, and coarsest towards the north, where only large stones or boulders occur. By studying the character of the transported rocks, the places from which they were carried has been ascertained, and in all cases they have been found to lie to the north of their present position. In regions where the material prevails, the surfaces of the outcropping rocks are frequently found cut into parallel grooves or scratches, clearly formed by the transported material while being carried over the face of the rock. Sometimes two or more sets of these scratches occur in the same rock, though their general direction varies but little. The scratches have been found at several thousand feet above the sea level. The period during which this material, which has been called the drift, was deposited, has received the name of the glacial epoch. Discarding the theory that the material was floated to its present location by icebergs during a period of complete submergence of the continent, we will endeavor to show briefly how thoroughly all the phenomena are explained on the supposition that the entire region now covered by the drift was once occupied by immense glaciers.

In glacial regions we have many instances of the ice-mass extending far down the mountain slopes into the valley below, and then during a succession of warm summers retreating far up the mountain's side. The portion of land thus left bare, affords an excellent opportunity for comparing the action of a known cause with the appearances presented by the drift material. In all cases the comparison shows a remarkable similarity. The rocky bed of the valley is found to be covered with striæ or scratches precisely similar to those found in the drift region; while all over the valley, though especially on the sides, are found accumulations of just such materials as characterize the drift formations. Here and there we find immense fragments of rocks, tons in weight, that have become detached from the mountain slopes, thousands of feet above, and brought slowly down by the ice; while the finer material is spread irregularly over the bottom of the valley, or heaped up in huge mounds at the sides or end of the glacier. The mounds are called respectively the lateral or terminal moraines. Now, it has been found that glaciers will move down slopes that have but little inclination, even two or three degrees sufficing, and, if it be imagined that the entire northern continent were covered with an immense glacier, all the phenomena of the drift period receive satisfactory explanation. Apart from this hypothesis, however, no adequate cause can be assigned for the transportation of masses of rock, thousands of tons in weight, over deep valleys, and their lodgment on the slopes of mountains, miles away from their place of origin. Besides, the supposition is by no means too violent to be entertained, since the extreme northern continent of North America is even now during the winter in the condition we have imagined, while Greenland is covered with perpetual glaciers.

From the evidence we have adduced it appears, then, that our earth has experienced at different times in its history the following climatic conditions over the whole or very extended portions of its surface: 1. In the early geological ages a tropical or sub-tropical climate extending from the equator to the polar regions. This climate has been shown to reach as far north as latitude 78° or 80°, and probably extended quite to the poles. 2. During a very extended period, reaching down to the time that almost immediately preceded the introduction of man on the earth, this hot climate underwent no decided change, when that of central North America became warm temperate, while apparently that of Europe passed more gradually from the tropical to the sub-tropical, and thence to the temperate. 3. That shortly after this termination of a general tropical climate, a very great change spread over the land, ushering in an Arctic cold, and wrapping the continents in eternal ice and snow. 4. The disappearance of this climate, and the introduction, after several minor changes, of the variable climate we at present enjoy. Let us now inquire if any sufficient physical causes exist which are capable of explaining these wide-spread fluctuations in the distribution of the earth's heat. For the sake of clearness we will first confine ourselves to the investigation of the causes that produced the extended tropical climate of the earth during the early geological ages.

Many ingenious suppositions have been framed to account for this excess of heat in early time. It was at first assumed that uniformity of the earth's climate was due to a change in the position of its axis; that it formerly stood perpendicularly to the plane of its orbit. Apart from the fact that such a cause, though explaining the equability of climate, would be inadequate to account for an increase in the amount of heat, such a change in the position of the axis can be shown to be an astronomical impossibility.

Poisson, the distinguished mathematician, has suggested that inasmuch as our sun and its attendant planets are not stationary, but are moving with immense rapidity through different portions of space, that they may sometime during the many millions of years that have elapsed since the creation of our solar system, have passed through regions of quite different temperatures; that coming within the influence of the radiation of suns hotter and fiercer than our own, the increase in the total quantity of heat received by the earth would be adequate to account for its former higher temperature. But it must not be forgotten that these suns or fixed stars are situated at such immense distances in space that they are but mere points of no appreciable magnitude; and that to make their radiation at all effective in the manner Poisson conceives it to act, would necessitate the approach of our system so near the star as to seriously affect its stability. And yet it is conceivable that there are portions of space so rich in systems and clusters of systems, that the more abundant and intense radiation would render the surrounding ether warmer than in other regions. Still it is doubtful that the earth's early heat was due to any such cause.

Another supposition has reference to a change in the total quantity of the sun's radiation; that the heat given off by the sun was formerly more intense than now; that the quantity has gradually diminished until it has attained the average of the present cycle. To examine this question thoroughly would carry us far beyond the scope of the present article, necessitating, as it would, an inquiry into the cause of the sun's heat, and the manner in which his average radiation is preserved. Suffice it to say that no apparent diminution in the total radiation has been observed during historical time, though we cannot therefore fairly infer that none has occurred; indeed, the following considerations render such a change very probable. Assuming Laplace's nebular hypothesis as true, then the sun's early radiation must have been vastly in excess of the present, since the temperature at which he threw off through centrifugal force each of the planets in succession must have been much higher than what he at present enjoys. It may be questioned, however, if this original excess of heat was not expended long before the geological ages we have been considering, for the rapidity of the cooling of a body increases very rapidly with the increase in its temperature. Still, this loss could scarcely have lowered the sun to his present temperature, and a portion of the increased heat of the earth can be thus accounted for. We should be careful, however, of assigning to this cause, which is purely speculative, undue prominence over other causes of greater probability.

Of the many theories that have been framed to account for maintenance of the sun's present radiation, none seem to accord so well with known facts as the meteoric theory. This assumes that the surface of the sun is constantly receiving showers of meteoric matter, which, falling from immense heights with an almost inconceivable velocity, have their motion arrested by the sun, and are then converted into heat. The quantity of this heat is capable of exact mathematical measurement, so that the sufficiency of the assigned cause is fully demonstrated. Now, in the early ages of the world the quantity of this matter was very probably greater than what now exists, and we may fairly suppose that the quantity received by the sun was greater at one period than another, and that therefore his heat would have been materially increased. This assumption, however, is even more speculative than the preceding, and merits but a passing notice.

Far more worthy belief is the supposition that our earth's early tropical climate is to be ascribed to the greater quantity of heat that escaped from its melted interior when the crust was much thinner than at present. Assuming the earth's original igneous fluidity—and the facts certainly appear to warrant it—more heat must have escaped during the early geological ages than now. Still, it may fairly be doubted whether the crust of the earth had not attained sufficient thickness, even as early as the Silurian age, to prevent a very considerable increase from this cause. Besides, an increase of temperature sufficient to have raised the climate of the polar regions so as to allow the growth of coal plants, or coral reefs, would have effectually exterminated the life of the tropics, since we must suppose the same quantity to escape in the equatorial as in polar regions. The thinner crust, however, beneath the ocean's bed must have imparted no inconsiderable heat to the water; and this, from the development of oceanic currents, could not have failed in modifying considerably the distribution of the earth's heat.

The vast quantity of coal now in the earth's crust must have originally all existed in the atmosphere in the shape of carbonic acid. Moreover, the air, at least during the carboniferous age, was densely laden with moisture, a requisite for vigorous plant growth. Now, it can readily be shown that this increased cloudiness and density of the atmosphere must have had a decided influence upon the temperature. Not all the heat which falls upon the earth is effective in heating the atmosphere; a large part of it escapes back again through the air, and is lost by radiation into space. But the quantity thus lost is by no means constant; it varies with the quantity of moisture in the air. It has been shown by recent and extended researches of Tyndall, on the effect produced on the diathermancy of the air, by the presence of aqueous vapor, that a very small quantity will materially affect the transparency or opacity of the air to certain heat rays. Of the more intense rays that came directly from the sun, only a part, amounting to not quite one-fourth of the whole, are absorbed during their direct passage through the air. The remainder strike the earth, heat it, and are radiated from it back through the air. Now, when the atmosphere is free from moisture, or contains only a small quantity, these rays experience but little difficulty in escaping through the air; but, as the quantity of atmospheric moisture increases, it acts by its presence as a screen, effectually preventing the escape of a large portion of the heat, and preserving it for the heating of the air. Now, since the quantity of moisture during the carboniferous age, and probably during all the earlier ages, must have been very great, the ability of the sun's rays to heat the air must have been much greater than afterwards, when the quantity of vapor sensibly diminished. Carbonic acid acts like water vapor, though less powerfully, and must have added sensibly to the general result. The heat, therefore, would have been greater even with the sun's present radiation. The influence of this cause must have been very great, though we have no sufficient data to render the effect at all a measurable one.

But the theory that best accounts for the earth's primal excess of heat remains yet to be considered. This theory has reference to the different distribution of land and water over the earth's surface at different periods, and its varying elevation above the sea level. It is a well-known fact that even at the present time the mean heights of the continents are undergoing continual fluctuations. Not only are the mountains being reduced in height and carried seaward by the rivers, but extended tracts of land are being slowly raised or lowered by the action of powerful subterranean forces. But it was during the geological ages that these changes were the most wide-reaching and decided. Every bed containing marine fossils, no matter whether now on the summits of the loftiest mountain, or on the low plains adjoining the sea shore, must have once been the bottom of an ocean or an inland sea. Formations containing successive strata filled with marine remains, alternating with those of terrestrial origin, witness the successive disappearance and reappearance of the land. During the coal formation these successive changes of level must have been very numerous, since their beds of coal are found alternating with sandstones, shales, conglomerates, shaly sandstones and limestones. Very numerous are these alternations of coal and its associated rocks, and yet every bed of coal witnesses the elevation of a low, flat marsh; while each of the other beds testify equally well to its subsequent depression below the water's level.

The testimony of geological science thus proving extended changes in the extent and elevation of the continents, it remains to be inquired what effect would thus be produced on the climate. The inquiry is twofold—first, as to the influence of variations in the relative quantity of land and water surface; and second, as to the changes in the elevation of the surface. Briefly expressed, these effects would be as follows. An accumulation of land in tropical regions would tend to increase the mean annual temperature over the entire surface of the earth; an accumulation in polar regions, to decrease the mean annual temperature; elevation of the land in either tropical or polar regions would tend to decrease the mean temperature. Combining the two causes, we see then that the greatest increase of heat would be produced by the accumulation of moderately elevated lands in the tropics, and their entire absence in the polar regions; while the greatest cold would be produced by the disappearance of the tropical lands and their elevation in polar latitudes. Should Greenland be connected with Norway by the elevation of even a moderately elevated land area, a cold would instantly result that would sweep whole genera of animals and plants from Europe and America; while an equally great increase of land in the tropical parts of the Pacific or the Indian oceans would be attended by a very decided increase of heat.

It may be objected that an increase of tropical or polar lands would only be sufficient to account for a local change of temperature, and not one of a general nature. A moment's reflection will, however, show the fallacy of such an objection. The constant interchange of the polar and tropical winds tends to carry the heat of the equator to the poles, and *vice versa*, while the same tendency to equalization is brought about even more powerfully by the oceanic currents—immense quantities of the tropical heat being thus transplanted to the polar regions. Indeed, no climatic change can occur in any part of the earth without affecting more or less the climate of other portions. Thus North America is colder in high latitudes than corresponding portions of Europe, on account of the temperature of Greenland and its adjacent islands; and yet, unquestionably, Europe is rendered cooler than it would otherwise be from the presence of its colder neighbor, while America is at the same time rendered warmer.

The general effect produced on the climate of any portion of the earth's surface by the undue prevalence of land compared with that of water is that of the great extremes of heat and cold. The climate of a large body of land is characterized by hot summers and cold winters; that of an equally large body of water in the same latitude is cool summers and warm winters. This effect is seen in the climate of oceanic and continental localities situated in the same latitude. Now the land and sea areas are by no means equally distributed over the earth's surface. In fact most all the land is collected in a north-western hemisphere, which has the western part of the British channel for its pole, while the south-western hemisphere is nearly all water. A superficial glance at a map of the world will show how greatly the land in the northern hemisphere exceeds that in the southern, and the difference in the climate of the two shows the truth of the principle we have just enunciated. Countries south of the equator have generally mild winters and cool summers.

To return now to the explanation of the earth's primal excess of heat. If we suppose that during the early ages most of the land accumulated at the equator, while the present polar lands were either entirely absent or confined to small portions but slightly elevated above the sea level, a supposition well sustained by a study of the different formations, then we have a physical cause that may be justly deemed sufficient to account, without the intervention of any other cause, for the early greater heat. Sir Charles Lyell, who strongly favors this view, to the exclusion of all others, has shown that even supposing the total quantity of land surface to have been no greater than what now prevails, a gathering together of all the land into the equatorial regions would be ample to produce a climate even warmer than that we have supposed to prevail during the early geological past.

Among the different causes we have mentioned as affecting the earth's early climate, the one just considered has been undoubtedly the most influential, though the importance of the others should be by no means disregarded. Leaving out of consideration the first two, which we have acknowledged as purely hypothetical, and possibly placing the third under the same category, the influence of the two remaining can by no means be deemed insignificant.

Having thus discovered the causes that probably produced the tropical or subtropical climate that prevailed during the early geological ages, and extended with little change very nearly to the age that preceded the introduction of man, we will now inquire briefly as to the origin of the intense cold that produced the glaciers, which we have shown to be sufficient to account for all the leading phenomena of the drift.

In reviewing rapidly the possible causes we have assumed as instrumental in producing the former excess of heat, it is clear that they may all, with the exception of the fourth and fifth, apply equally well to a diminution of heat. A change in the position of the earth's axis, by means of which the southern hemisphere would receive continually the vertical rays of the sun, would undoubtedly produce a very great change in the earth's climate, quite sufficient to account for the development of glaciers over the northern hemisphere. The cause, however, is barely possible. Again, if it be granted that different portions of space have different temperatures, or that the quantity of heat radiated from our sun is subject to fluctuations, either of these causes may be urged as possible in explaining the necessary reduction of temperature. The cause that we have shown to have been mainly instrumental in producing the excess of heat is quite sufficient, when acting under somewhat different conditions, to account for the production of a very intense cold. While an accumulation of land in equatorial regions produces an increase in the earth's mean annual temperature, its elevation and increase in polar localities will produce a very considerable reduction of temperature. Now, all the conditions requisite for the existence of glaciers over the entire frigid and temperate zones of either hemisphere would be satisfied if we suppose that a moderate elevation of the land to have taken place. A careful study of the formations of the period proves conclusively that extensive elevations in high northern latitudes actually occurred on the North American continent; and if we assume that these elevations reached the height of 4,000 or 5,000 feet, no other cause need be assigned for the change in the earth's climate. The subsequent subsidence of this tract to its present position would have gradually brought about the climatic conditions that now prevail.

DOWN IN EGYPT.

THAT part of southern Illinois lying below the Ohio and Mississippi railroad has for years been popularly known as "Egypt." Whether this name, as originally applied, was intended as a sneer or a compliment, is not certain. It may have been meant to designate the benighted and behind-the-times character of the people, and in this light, years ago, it was generally accepted, it is said, as an exact fit. But in these later days the appropriateness of the term is more than ever evident, in a new and almost opposite sense; no longer the expression of lack, but of abundance—not referring to characteristics, but to crops. As the granary of the West, this is indeed an Egypt. Nowhere in the broad country is Jerrold's arcadia—where all you have to do is "tickle the earth with a hoe, and it laughs with a harvest"—so nearly realized. The markets of St. Louis and Chicago, which handle the products of this vast, rich field, look hither for the choicest wheat, the plump corn, the luscious fruit. Throughout the entire East, that famous commodity known as "St. Louis flour," is none other than the product of the fields and mills of southern Illinois. In a single county, that of St. Clair, we find no less than thirty large mills, each turning out from fifty to four hundred barrels per day. The chief, we might almost say the entire freight, of one of the railroads—the St. Louis, Belleville and Southern Illinois—has for years been flour. Flour trains have been as much of a specialty as coal trains on the Lehigh Valley railroad; and twenty-four car-loads a day for nine months of the year have been considered about an average run, from points along the line (chiefly Belleville and New Athens), into the St. Louis markets. Many large commission houses, at that point, are solely occupied with handling and shipping this product. And then from all the other counties southward, *via* the Illinois Central, the St. Louis and Southeastern, the Cairo and St. Louis railroads, and the boats of the Mississippi, this vast granary pours out its treasures. One will see on every hand, from August to January, a constant string of farm teams threading the roads from the interior towns to the nearest railway station or steamboat landing, while hundreds daily cross the ferry into St. Louis. In travelling through this region, everywhere huge corn-cribs are seen, many of them still holding the remnants of last year's crops, while the neighboring shocks betoken the abundance of the new harvest. So, on all sides, there is the look of thrift and plenty. The Eastern States, the far West, and Europe, even, in their years of scarcity, have come down into this "Egypt" for their breadstuffs.

Another product of this region, quite as important and wonderful in extent, is coal. The St. Clair, O'Fallon, and Big Muddy mines, are all within "Egypt." The St. Clair mines, developed chiefly along the route of what is known as the Cairo Short Line railroad, between Centreville and Duquoin, number no less than twenty; the veins running from four to ten feet in thickness, and some of the mines turning out one hundred tons per day. The daily product along this one line of railroad is upwards of two thousand tons. Of this amount, the mines between Belleville and Centreville furnish three-fourths, sending an average of one hundred and thirty car-loads a day to the St. Louis market the year round, while the balance of the mines east of Belleville ship about forty car-loads. The principal mines are at Gartsides, Ogles, Raibs, West Belleville, Beaucoup, Duquoin, Pinckneyville, Coulterville, New Athens, and Wilderman's. The bluffs, from Belleville to Centreville, a distance of eight miles, are, on both sides of the railroad, completely honeycombed with mines. And then, the Pittsburgh railroad, running from the dyke at East St. Louis to the bluffs below Belleville, is hauling from its mines from forty to sixty car-loads of coal per day. The Southeastern railroad takes from the same field about forty car-loads a day; the Ohio and Mississippi, chiefly from O'Fallon and Caseyville, one hundred car-loads; while the Vandalia, and the new Cairo and St. Louis narrow gauge, handle large quantities. It is estimated that the mines of St. Clair county alone yield four thousand tons per day; and there are no signs of giving out. The developments have been gradually greater, and the demand constantly increasing, during the past ten years. St. Louis is chiefly dependent on this region for its fuel; and its manufacturing establishments, now so numerous, are kept alive from this source. Indeed, the opportunities for extensive manufactures have of late been inviting capital in this direction, and the rail mill and coke works at East St. Louis, and the nail mill at Belleville, are among the results. The latter turns out over four hundred kegs of nails per day, and gives employment to one hundred and twenty men and boys. The numerous iron works of South St. Louis and Carondelet are constantly being increased in capacity, number, and variety; indeed, the results of the past five years in this direction have been truly wonderful.

The outlets for the large products of this rich territory are naturally of the best. On one side is the Mississippi—on the other the Wabash and Ohio, while, intersecting it in all directions, are numerous railways. While the towns are none of them large, yet the country is more evenly and thoroughly settled than in most parts of the Western States. The farms are large and well tilled, the farm-houses neat and tidy, the people intelligent and warm hearted. In some respects they are a people unto themselves—more frugal, care less about dress and forms, and less given to political and religious isms, than their brethren in the North. They are slow to fall in with anything new, and though always having large interests at stake, are seldom found in convention with their grievances or demands. The "grange" movement, although originating across the Mississippi, in a neighboring State, and raging there with considerable force, has met with scarcely any attention from the farmers and fruit-growers "down in Egypt." In the early settlement of this, the flowering part of the Garden State, there was such exaggerated promise and grand expectation that a little reaction soon set in, for a time retarding its growth and development. From this point venturesome Easterners would go back with high-colored plots of new and full-grown towns, which were to expand without limit. Many an honest stay-at-home was lured into the trap, and bought town lots, on outlying farms, on paper, finding, to his sorrow, as he approached his new possessions, that the best he had secured was swamp lands and the ague. No doubt Dickens, in one of his best novels, wherein he has been accused of caricaturing the American character, had in mind the tricks and shams that were perpetrated upon the Western emigrant, who, in years agone, hied his way "down into Egypt," and having gone with gleaming expectations and buoyant hopes, went back to his native heath a sadder, but wiser man. But those days were long since past. A throng of industrious, determined people flocked in to "possess the land," and whatever may have been the early drawbacks from lack of transportation or the lay of the land, they all have long since been removed. Here are busy, prosperous towns; broad, handsome farms; rich mines; the look of contentment, thrift, and plenty; and nowhere will one find the American idea of "getting on well in the world" so well and admirably exemplified as "down in Egypt."

TECHNICAL EDUCATION.

THE problem of how best to adapt the educational systems of our country to the imperative demands of practice, is one which of late years has received careful attention on the part of professional educators and others, and the collegiate system of our country has been made the subject of exhaustive inquisition.

The origin of this scrutiny into its workings is clearly manifest in the widespread and well-founded opinion that, as at present carried out, it is lamentably insufficient to afford to the great majority of students that preparation which they would find useful or available in their future professional pursuits. The plan so long followed of forcing all alike to take some prescribed course of instruction, whether the studies therein included could be shown to be of future service or not, which, some years ago, was that almost universally followed in the higher schools of the country, has happily, as one of the immediate results of this inquisition, been in many instances considerably modified, and in others entirely abandoned, to make way for the innovations demanded by the practical needs of the day.

The wonderful progress of the natural sciences in our times, and the influence which they indirectly exert through the numberless channels by which such progression finds its application to the useful arts, has made it urgent that a knowledge of these things, so vastly important in the affairs of the world beyond the school, should be taught there. The outgrowth of this has been eminently wholesome, though the changes in the systems of instruction, which it has forced, are by no means so radical as the advocates of the "new education" could desire; seeing that though the needs of our own country in this respect are larger, broader, and far more imperative than those of others, the contrast between what we are able to afford to the student who seeks technical instruction to prepare him for entrance into any of the engineering or mechanical professions, and the facilities for such instruction which he may find in European countries, shows that we are still lamentably behind the demands of the times. We need imperatively the educated skill of workmen in every department of technical knowledge, to rationally direct the tillage of our countless acres of productive soil, to tap with the magic wand of science the rocky ribs of our mountains and hillsides, and force them to disgorge their hidden treasures; and especially do we need the designer and constructor of the machinery by which the skilled laborers in other fields may multiply their powers.

For the utilization of our rich natural resources the aid of science is necessary on every hand. In agriculture, in architecture, in engineering—mining, civil and mechanical—and in numberless other fields of industry there is a demand for intelligent, thoroughly trained and skilful men, and there is but one way in which such men may be secured among us, namely, by training them ourselves. To train them we must afford them all the educational advantages which can be obtained abroad; hence the establishment and development of technical systems of education becomes a subject of the utmost importance to our national prosperity. That the necessity of training men to become the intelligent masters of the scientific principles underlying the practice of the useful arts, is receiving something of the appreciation which is due to it, is manifested not only in the enlarged attention given in our colleges to science studies, and the very general breaking down of the barriers which formerly hedged in the inflexible and traditional curriculum, and the planting side by side with it of the elective system, but likewise in the establishment of numerous specifically technological and industrial schools, having for their object the establishment of a closer relationship between the school and the practice beyond it. As may be expected from the comparatively recent inauguration of such schools as those of the last-named class, their methods and interior organization are as yet comparatively imperfect, and their facilities limited. We should be thankful, however, for what little has been accomplished, and may with confidence anticipate that the movement in the direction of closing the breach between theory and practice will gather strength with every coming year.

An example of a technical school, as developed in the foremost European countries, will afford us a clearer conception of the imperfections of our own schools by contrast, and on that account the following outline of an average German polytechnicum is presented:—

In Germany, it may be well to state, the entire educational system, from its highest to its lowest departments, is under the direct supervision and maintenance of the government. The question as to the propriety of government undertaking the higher education of its citizens is not a matter of discussion—it is assumed as a duty and a privilege. The consequence may be seen in a thorough systematization and mutual interdependence of all the schools, from the highest to the lowest. Every school forms a part of a great system, and sustains a rational relation to others, and the grading of the schools is made with a view that they shall present a gradually ascending plane with no breaks in continuity. Each lower grade is preparatory to the grade above it, and the higher school begins where the next lower left off. Recognizing the necessity of supplying the wants of that great class of pupils who intend to devote their lives to technical pursuits, there is introduced at a certain grade a diverging point, from which the one branch leads to the university, which may, loosely speaking, represent the literary branch; the other culminates in the polytechnic school—the polytechnicum. Up to a certain point, it will be observed, the course of study for all pupils is uniform. Beyond it there is the gymnasium, a preparatory school for the university, and the real school, the preparatory school, for the polytechnicum. The student destined for the polytechnicum leaves the real school fully prepared by systematic training to commence at once the study of the higher and technical branches. The elements of general studies underlying the trade or profession which he expects to pursue have been thoroughly mastered, and it only remains for him to give his further attention to the special development of those branches closely related to his future pursuits. The higher school is not hampered with the preparatory training of its pupils, but only with the strictly professional education of those thoroughly prepared to appreciate and comprehend.

The following synopsis of the course of instruction pursued in the German polytechnic schools has been reproduced from a late report upon improved systems of technical instruction made to the trustees of the Rensselaer Polytechnic Institute:—

"The school contains the following departments: 1. The mathematical school, which is designed to comprise, in a separate course, nearly all the mathematical instruction which will be required, and thus leave the other and technical course free and unhampered. It is preparatory for three of the strictly technical courses, and the graduate in this department is still not entitled to a professional degree. The time of study in this department is two years. 2. The school of civil engineering. In this the studies are almost purely technic and practical, with some branches of higher cultural studies. The candidate must be graduated at the mathematical school, or show that he possesses an equivalent amount of knowledge. The course in engineering proper is two and a half years. 3. The school of architecture. The candidate must have graduated at the mathematical school, and his technical course lasts four years in addition. This is reckoned the most difficult and most learned of all the scientific professions, and perhaps a six years' course of preparatory study may in some degree account for the precision, economy, and taste of the German architects. 4. Schools for foresters. The forests of Germany and France are under the protection of the government, and are cultivated scientifically, and in such a manner as to yield a constant and important revenue. The officers in charge of them are usually government officials, who are required to be men of education. Hence, nearly every polytechnic school in those countries has its department of forestry, which is taught like any other useful art. The candidate enters the school either from the gymnasium or the real school, and is not required to pass through the school of mathematics. The course is three years. 5. This department conducts the education of certain classes of manufacturers, of chemists and druggists, and is, besides, a preparatory course for the mining schools and for metallurgy—branches which are taught separately—in great establishments like the Freiberg school of mines and the Leoben metallurgical school. The preparation varies with the destination of the student, who must be at least 17 years of age. The time of study is also variable. 6. Mechanical engineering. The preparation must be in the mathematical school, and the technical course is two years. 7. Commercial school. The student enters from the real school and studies one year. 8. School for the education of employés of the post-office. The student enters from the real school and studies two years. The course includes arithmetic, geography, political economy, popular jurisprudence, commercial law, the mechanics of transportation, modern history, French and German literature, and the English language. Thank God, there is one country in the world where civil employés of the government are required to know something. 9. Agricultural school. The student enters from the real school and studies two and a half years."

Upon this detailed synopsis the committee comment in the following terms:—"Here there are nine departments, or, if you prefer, eight technical departments and one preparatory. Some polytechnic schools comprise more. But the branches of mining and metallurgy even then are taught in separate schools, located, the one near the mines, the other near extensive furnace districts. All this may serve to convey some idea of the wonderful refinement of the science of education in Germany, and the exquisite adaptation of its means to ends. But how painful and humiliating the contrast, when we turn to our own country, where the field of the engineer or artisan is the widest, and where his education can be made to yield the largest results in economy of production and rapidity of development, and yet where the advantages of education are often doubted or even ignored."

At the present time there are comparatively few schools in the United States which even resemble in their objects the polytechnic schools of Germany, and none which even approach them in the extent of ground they cover, nor in the thoroughness of their means and methods of instruction.

Some of our technical schools are doing most excellent work in the direction of enlarging their scope of usefulness, and the impression they are making upon the educational system of the country is manifesting itself more and more; but, withal, we are, despite our imperative needs, without a rational system of technical education. The Rensselaer Polytechnic Institute, the Stevens and the Massachusetts Institutes of Technology, progressive and admirable schools, at present represent almost of themselves the entire resources available to one who desires technological education; while of the industrial schools—in which the main effort seems to be directed towards engrafting upon practical work in the machine shop, some knowledge of the theory of the work—the Worcester Free Institute may stand as the type. Aside from these very limited educational facilities, there is no way open to our engineers, mechanics, artisans, and other workers in the useful arts and sciences, to become educated in the principles underlying their respective callings, except through the medium of their own exertions, with the aid of their technical journals, the comparatively inefficient public lectures for workingmen, or attendance at the meetings and debates of scientific societies. Our manifest deficiencies in this respect cry loudly for remedy. We need educated mechanics more than skilled workmen, for from the talents of the former class spring the improvements in processes and machines which enable unskilled workmen not only to compete successfully with the skilled, but even to number their trades with the lost arts. It is from the class of educated engineers and mechanics that all industrial progress must be expected. The technologically educated workman is not the "hand" pouring this dye stuff into that trough, or mixing this compound of red stuff with that compound of blue stuff, simply because it is the custom of his factory to pour and mix in this manner; or fitting this part of a machine to that without an idea of their mutual relations, or of the functions which each are to perform; but the intelligent "head," understanding that the chemical changes and the mechanical effects which he brings about, are not the result of accident or good luck, but that they are arrived at through the operation of certain known chemical and mechanical laws, which laws he fully comprehends and is able to apply to the explanation of other processes, or to employ in evolving new ones. Intelligent labor is supplanting, and must everywhere continue to supplant that which is ignorant, or unreflecting; and that nation will be the most prosperous and powerful which strives most urgently to cultivate the intellect of its workers. This is effected only by the establishment of well-organized technical schools—a want which was never more urgent in our land than at the present time.

THE SYSTEM OF HIEROGLYPHICS.*

THE term "hieroglyphics," derived from the Greek *ἱερός*, sacred, and *γλύφειν*, to engrave, in stone or metal, may literally be translated by "sacred engravings or sculptures," and serves, in the first place, to designate the picture-writing used by the ancient Egyptians, but then, also, any other system of writing by means of pictures. The Chinese system can really no longer be called hieroglyphic, although originally consisting of pictures, because its single characters have, by abbreviations and interlacings, assumed such conventional forms, from which their prototypes can no longer be recognized, and because it also is but rarely used for sacred inscriptions in temples and on monuments. We use, moreover, the term hieroglyphic in a figurative sense, whenever our aspirations after knowledge meet with an obstacle in the obscure form of the object, however worthy of our knowledge, towards which we direct our energy.

Here we wish to deal exclusively with Egyptian hieroglyphics, to which this name was originally applied. In doing so, we shall have to consider the *extent* of the material for writing purposes left to us by the ancient Egyptians, the different *kinds* of writing and their uses, the *language* underlying them, the *means* by which they could be deciphered, the *decipherers*, the *elements* of the hieroglyphic system adapted to the innermost peculiarities of the Egyptian language, and the *signification* of the writings newly disclosed to our understanding.

The period of time during which hieroglyphics were used for writing purposes is much longer, and the extent of hieroglyphic literature accordingly much greater, than is generally thought. For more than three thousand five hundred years this kind of writing was used on the borders of the Nile. We shall further see that the educated classes among the ancient Egyptians made a similar use of the art of writing, and availed themselves of writing, even for monumental purposes, to a greater extent than we. Already, from the Greeks, we know that the learned sacerdotal colleges at Memphis, Thebes, and Heliopolis, had acquired a considerable treasure of knowledge, and it is established by well-authenticated testimonies that some of the profoundest Grecian thinkers visited Egypt for the purpose of enlarging their knowledge. They never speak of any disappointment they met in this pursuit, but mention the difficulties they had to overcome before they were admitted into the schools, which were open only for natives. A part of these treasures of the knowledge of Egyptian priests lies now open before us. To acquire and preserve them would have been impossible without a system of writing by which experience and thoughts could have been fixed; and the Egyptians wrote much and diligently, in obedience to a deep-rooted tendency, which characterizes all Egyptian antiquity, viz., the aspiration after preserving individual life beyond death. This aspiration finds its expression, on the one hand, in the imperturbable belief in the immortality of the soul; on the other, in the decoration of tombs in which the Egyptian endeavored to preserve his living memory in the consciousness of future generations by pictures and writing, together with the memory of all he loved and cherished, inherited and acquired. This prominent aspiration after an objective enlargement of personality, characterizing Egyptian antiquity, is illustrated by hundreds of such tombs. After them, we have to mention those structures, the vast magnitude of which gave rise to the superstition among Arabian descendants, that giants had built them who were able to move masses of rock by the aid of magic wands. Every such temple may be called a folio-volume of stone; for every court-yard, every hall, every apartment, every wall, the pillars, the architraves, and often even the ceilings, serve to the sacerdotal architect as a means for introducing so numerous inscriptions, that even on the most expanded surfaces the eye looks in vain for an empty spot. Moreover, the obelisks and colossuses before the temple gates, the sarcophagi, monumental tablets, statuettes, vases, amulets, and implements, large numbers of which have been found among the ruins of the cities of the dead, situated in the western part of every place of the ancient Egyptians, bear, without exception, often smaller, sometimes larger, occasionally very important, but *always* instructive inscriptions. Like stone and wood, but in a more aristocratic manner, the Egyptian fibrous paper, prepared from the papyrus reed, which in ancient times also grew in lower Egypt, but now thrives only on the borders of the white Nile, was used for written records of all kinds. In Greece and Rome the Egyptian papyrus was considered the most excellent writing material; and its excellence and durability have been most strikingly established, since numerous rolls of this material, with the writing contained in them, have been preserve for four thousand years, and exhibit even to-day such great firmness that they can be unrolled without artificial means, and fixed most conveniently between glasses. The most voluminous roll of papyrus extant, now in possession of Miss Harris, the daughter of the late English consul at Alexandria, measures one hundred and forty-four feet. Many are twenty feet long—few wider than one foot. We possess a very large, still constantly increasing, number of these documents, but could claim far more yet, if it were not for the reckless ignorance of the Fellahs. Nicolaus Show relates occasionally of his first publication in 1778, of a Grecian-Egyptian papyrus, that it had been bought by a European merchant from some Arabs who had found it, together with forty or fifty others, in a box of sycamore wood. This one copy the merchant sent to Cardinal Borgin, the others he saw the Arabs throw into the fire, "to enjoy the fragrant smoke."

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* From the German of Dr. George Ebers.

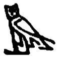
The literary legacy of the Egyptians is very considerable as to its quantity. It would, of course, have been much more scanty, had not the valley of the Nile placed vegetable and mineral writing materials at the disposal of the writer and sculptor, so difficult to be destroyed as papyrus, granite, alabaster, limestone, and other hard rocks, and had not the perfectly dry air prevailing there aided so much in their preservation.

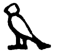
Now, several passages in ancient writers, from Herodotus down to Clemens, of

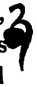
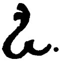
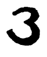
Alexandria, inform us of the existence of different styles of writing, in adaptation to so rich and manifold a use of the art of writing. Even only a superficial comparison of the papyri with the monumental inscriptions, and of the former with each other, proves the complete correctness of this information. The Egyptians could not be satisfied with *one* style of writing, but similarly as we use a special kind of writing for public monuments, the large Roman letters for books, printed characters and the "current hand" for private use, so they possessed the *hieroglyphic*, the *hieratic*, and the *demotic* styles of writing.

The first and most ancient is the *pure hieroglyphic writing*, which consists of distinct pictures of concrete objects from all realms of creation and art, as well as of mathematical and capriciously invented figures, and which may be considered as monumental and lapidary writing in the proper sense of these words. Wherever it is used upon papyrus, we may be almost sure that we have to deal with sacred things. For the Egyptians themselves, it had both an artistic and literary signification; for while on the latter it is exclusively used for giving written expression to ideas, on the former it serves the architect especially for ornamenting his structures. Every temple furnishes the evidence for this statement. Long rows of hieroglyphics, in which the single characters often attain to a considerable size, cover in symmetrical order—sometimes horizontally, sometimes vertically—the broad surfaces of the immense walls and pillars. If they were empty, the eye would wander upon them without any point of support and grow tired, while now not only the gaze of the observer is captivated by the variety and the brilliant coloration of the pictures, but curiosity and thirst for knowledge are excited by them. Often they are not only painted, but even chiselled into the stone as reliefs. Thus the pictures are at the same time letters, the rows of paintings sentences, and the entire richly-ornamented wall is a book, the religious and historical contents of which excite and gratify the thirst of the inquirer for knowledge, and the picturesque wants of the layman.

Into all monuments of stone, such as obelisks, sarcophagi, &c., they were, of course, chiselled; upon the limestone or stucco of the vaults, usually painted in such a manner as to show the objects which they represent, either colored or only in black and red outlines. The latter kind of hieroglyphics was, with the entire abandonment of their internal execution, more written than drawn, by means of a reed; whenever it was intended to write upon papyri, which never show many-colored hieroglyphics, only the beginnings of the sentences of the black written texts are indicated by some red letters.



The owl, which answers to our letter *m*, was, therefore, in the polychrome ornamental hieroglyphics, if we may so call them, painted with brown wings, yellow feet and eyes, and a black beak; while in most of the dead records, which, on account of their sacred character, were generally written in hieroglyphics proper, it is thus represented:  The pure hieroglyphics are used for *inscriptions* of every kind, though seldom of a profane order, and upon papyrus exclusively for religious texts.

For a rapid production of voluminous writings, even the simplified symbols of the dead record occupied too much time, which gave rise to the *hieratic* style of writing, in which the owl, hardly any longer distinguishable, was written thus,  or . It occurs almost exclusively upon papyrus, and has preserved to us writings of a religious and magical character; but, also, historical records in prose and epic form, documents of various kinds—even works of fiction, among which there is a fairy tale. The first hieratic papyrus originated between the years 3000 and 2000, B.C. Its sacerdotal author displays in it already that boldness and vigor of pen which astonishes us in all hieratic writings. It may here be incidentally mentioned that the Phœnician letters, which form the basis of our alphabets, seem to be derived from the hieratic style of writing. The *demotic* style first occurs in the eighth century, B.C., and is already so far removed from the hieroglyphic style, that in its single symbols the prototypes from which they are derived can be recognized only with difficulty, or not at all. The owl is written thus:  or only . It was mostly used for civil purposes, and was called by the Greeks the letter-style of writing, and requires already on that account a special study, because it is founded upon other forms of language than the hieroglyphic and hieratic documents, all of which were written in the same old sacred dialect.

The farther the latter was removed from the living, spoken language, the more urgently was the want felt for a new style of writing adapted to the living tongue. Thus originated the *demotic*, and afterwards—though only in the second century of our era—the *coptic* writing, which expresses the living language of the Egyptians spoken at that time, in Greek and some additional characters borrowed from the demotic alphabet, and which is even to-day used for religious purposes by the christian monophysitical sect of the Copts, who live almost exclusively in Egypt, but now speak only the Arabic language. We possess many coptic writings, mostly of an ecclesiastical character,—the biblical books of the Old and New Testaments (both canonic and apocryphal), liturgic and patristic, exegetic and homiletic, and finally, such manuscripts as belong to the department of hymnology, gnostic philosophy, profane history, and medicine.

We saw that the hieroglyphic and hieratic characters were founded upon the ancient sacred language which was spoken in Egypt already in the fourth century, B.C., while the coptic letters express an idiom which was spoken at the same place only in the Christian era. Now, it is true that we fully understand the coptic language, but does this also involve for us the knowledge of the *oldest* linguistic forms, upon which the hieroglyphics are said to be founded? Every linguist will be inclined to answer this question in the negative, for it would be an almost unheard-of precedent that a language should, through a period of nearly four thousand years, have preserved such a stability that it could lead us, without any intermediate studies, to the understanding of linguistic forms that are younger by four thousand years; while it is indeed a fact, established by long series of observations, that languages are undergoing changes as long as they live. They are natural organisms, originating independently of man's will, growing and developing, according to fixed laws, but finally receding, and eventually perishing.

The period between the years of the builders of the pyramids and those of the coptic christians, is probably not shorter than that which was necessary for the

German language to develop itself from the Sanscrit; and what German would succeed, even with a full knowledge of the old Indian alphabet, in understanding the writings of the old Brahmins? Yet, with reference to the language of the Egyptians, such an apparently unheard-of proceeding can be shown to be a matter of fact. The coptic dialect is hardly further removed from the most ancient forms of the old Egyptian language, than the Italian from the Latin. This fact is, no doubt, in the first place, attributable to the peculiar tendency of the inhabitants of the Nile regions, to whom nothing was more imposing and appropriate than to cling not only to every possession sanctioned by years, but more tenaciously yet to the manner in which that which once had been seized upon found its further treatment and development. The reluctance of subjecting the valued and tried forms, even to the least alteration, meets us in the works of the plastic arts, in religious institutions and civil customs, not less strikingly than in their language; and we face here no *accidental*, but a *necessary* phenomenon, especially if the laws, mainly established by Schleicher, are true, according to which, in the first place, a nation changes its language so much the less, the more firmly it adheres to one and the same place of residence; and that, in the second place, the language of a people living in active intercourse with other nations, is more liable to various changes than one living in perfect seclusion. Now, the Egyptians have, during the whole long period of their historical existence, never left their habitations; and, moreover, on their fertile land, which is strictly secluded, between the Libyan and Arabian mountain-range, from the outer world, like an oyster between its shells, carefully and with full consciousness avoided all contact with other nations, who, in their mere quality as *foreigners*, appear to them contemptible and hateful. Thus it comes that the coptic dialect, though of course *deviating* in many points from the forms of the oldest Egyptian language, yet may accord with the fundamental language of the hieroglyphics. Now, if the old picture-writing, similar to writing, or to the Semitic manner, offered nothing but a symbolry of the sound of the spoken idiom, expressed by a limited number of letters, it would have been easy and simple to decipher it. But it was known, through Greek and Roman writers, that the hieroglyphs contained symbols of various kinds, and the mere fact that even the most superficial observer is struck by the great number of these symbolic characters (of which there are about 3,000), could not give rise to the thought that this was here a mere phonographic style of writing. Misled, especially by the work of the later Greek writer, Philippos, who, in his book regarding the hieroglyphs, pretends to translate the work of an Egyptian Horus (or Apollon, according to the Greek version), the investigators of this subject considered themselves at first justified to regard every picture as the direct or symbolic representation of an idea, not of a sound or of a syllable; in short, they thought of having to deal with a purely ideographic style of writing. Such a one was and is, no doubt, even in our time, still used by the red-skins who, *e.g.*, when they wish to give written information of the landing of three boats, paint three canoes followed by a turtle, to represent in a symbolic manner the process of landing.

As long as the first modern decipherers considered the hieroglyphs to be a similar ideographic style of writing they could of course attain only such results as necessarily excited the distrust and afterwards the merriment of critical investigators. We will here only instance the well-known guesser of hieroglyphs, Father Athanasius Kircher, of Fulda, who, when death put an end to the important scientific activity of the octogenarian at Rome, left many physical and archæological writings of no small celebrity, useful coptic vocabularies, and, what is to be regretted, also many attempts at deciphering hieroglyphic writings, an example of which may show to us to what absurdities a learned scholar may be led by the consistent application of a wrong principle (of the correctness of which, however, both he and his surroundings were fully convinced to the time of his death in 1680). He translates the Greek title of Cæsar *αὐτοχράτωρ* (autocrate), written with ten simple phonographic hieroglyphs, in which he considers every character not the representation of a sound, but of an idea, in the following manner: The creator of fertility and of all vegetation is Osiris, whose power of generation is drawn from heaven, his dominion, through the holy mophta.

More considerate than he proceeded the Danish scholar Zoëga, likewise living at Rome, without, however, possessing the means of ridding himself of the fundamental errors then shared by everyone. Yet we are indebted to him, and to those who before 1799 were engaged in investigating the old Egyptian style of writing, for one important result. They brought it about that when finally the first reliable means was offered to reveal the so long preserved secret of the Egyptian sphinx, the investigators found the coptic dialect as a ***known*** language, illustrated by lexicographic and grammatical aids.

With the expedition which the consul of the first French republic, General Napoleon Bonaparte, led to Egypt, a new epoch begins for Egyptian linguistics and archæology. As the crusades opened the East to the knowledge of the West, so this French expedition (which already Leibnitz had urged upon Louis XIV) brought surprising information regarding the still extant wonders of Egypt to Europe. Soon the reports of the soldiers were supported by artistic pictorial representations of Egyptian ornaments, and accurate copies of the inscriptions covering them made, by competent scholars. Among the latter was the well-known inscription of Rosette, which made it possible to scientifically decipher the old Egyptian monuments.

A French engineer, Lieutenant Bouchard, had been so fortunate as to discover it in 1799, while engaged in throwing up the breastworks of St. Julien at Rosette, near the mouth of the Nile of the same name, on a large tablet of black basalt. Plaster-casts of the monument, which in the further progress of the work came to London, are now found in many museums and libraries. Being 10 feet high, by 3½ feet wide, the tablet has by bad accidents lost pretty large fragments at the corners. Its space is covered by three inscriptions. The first one consists of pure hieroglyphs; the second of demotic letters; the third is written in the Greek language with Greek uncial (capital) letters. The 54 Greek lines are well preserved and plainly legible. The hieroglyphic portion consists of 14 lines, all of which are damaged on the right side; 12 on the left side. The whole is a sacerdotal decree in honor of Ptolemaios Epiphanes. It begins with the very prolix titles of the Pharaohs, announces to the young king that the priesthood have resolved to thank him for the numerous benefits bestowed upon the country and the favors granted to the clergy, and decrees that the highest honors should be shown to him, and his statue erected in every temple by the side of the principal deity. All kinds of divine honors were to be given to him and his images, and all this, enumerated with overflowing prolixity, is to be recorded on monuments of hard rock in hieratic, demotic, and Greek characters, and to be placed in every temple of the land. The great importance of this double inscription is self-evident. The Greek text contains the statement that its contents are identical with those of the hieratic text, and thus the tablet of Rosette gave to the world for the first time an old Egyptian written document with a Greek tranation.

In the hieroglyphic texts there was picture close to picture; only some single groups were, so to say, framed in by elongated rings. The Greek portion of the inscription contains some names, especially that of the Ptolemæi. If the latter could be singled out from the hieroglyphic portions much was gained, and this was possible, since already, before the discovery of the tablet of Rosette, such scholars as De Guignes, Barthelemy, and Zoëga, had expressed the supposition that the forementioned inclosed groups which had first been observed on obelisks might be names of kings, and distinguished as such by their inclosure. In the first place the decipherers went to work in examining the demotic text which they considered to be written in phonetic characters, and among them, especially S. de Sacy and the Swede, Ackerblad succeeded in finding by calculations which of the inclosed groups probably represented the name Ptolemaios.

The next question that suggested itself was, whether in the pure hieroglyphic portion of the inscription, the most frequently occurring inclosed groups expressed the same name. This might, no doubt, be the case, and soon men were found who, upon the basis of this possibility, went to work trying to decipher the inscription.

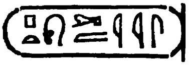
What, in the first decades after the discovery of the tablet of Rosette, was done of importance towards deciphering its inscription, is connected with two names, viz., Thomas Young, to whom the priority of the discovery belongs, and François Champollion, who, to be sure, came forth somewhat later than the Englishman with his discoveries, but who, even if he based his works upon those of the latter, which he denies, so far surpassed his rival in every one of his further works in the department of hieroglyphics, that not only his own countrymen, who are so slow in acknowledging the merits of foreigners, but also the Egyptologians of all other countries, call him the real founder of their science.

The Englishman, Thomas Young, born in 1773, was a man so distinguished in the most varied departments of science that his name is as celebrated among physicists, physiologists, mathematicians, and physicians, as among Egyptologians. Already, when but a child, he was an independent inquirer, and as a man he exhibited an incredible energy, by the aid of which he rendered apparent impossibilities possible. His biography, left to us by Arago, in one of his most beautiful eulogies upon the deceased members of the French Academy, is worthy of recommendation to all. Young directed his attention in the first place only to the inclosed groups, and was soon enabled, by mechanical comparisons of papyrus death records, which must be considered as difficult as they were ingenous, and for the detailed explanation of which space is here wanting, to declare the most frequently occurring inclosed groups in the tablet of Rosette as the name Ptolemaios. Also other names, such as that of Berenike, he correctly recognized, though erring in details; yet his is the merit to have been the first who, though only with reference to *proper* names, declared hieroglyphs to have been *phonetic* symbols.

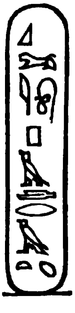
François Champollion's (born in 1790, at Grenoble,) works are of a far greater importance. Already, when but a boy, the news of the charms of the valley of the Nile, awakened to new life by the sons of his own nation, fell like an electric spark into his soul. Accordingly his vigorous mind took already in early boyhood that direction to which he was to adhere down to his too early death. In his 16th year already he was able to publish the precious work, *l'Egypte sous les Pharaons* (Egypt under the Pharaohs), which, especially in the enlarged form given it in 1814 by its author, even in our days is still indispensable for all those who are engaged in the study of the old Egyptian geography. In this book we are particularly surprised by the extensive knowledge of the youth in coptic language and literature, which was of essential service to him in his works of deicphering the hieroglyphs.

As to the question regarding the priority of the discovery, we will remark, that Young's first attempt at deciphering the hieroglyphs dates from the year 1819, while Champollion's letter to Mr. Dacier, in which he was able to communicate already a portion of the hieroglyphic system to the learned world, was finished September 22, 1822. In order to attain his end Champollion had first singled out the name of Ptolemaios in the tablet of Rosette, and afterwards the inscription of an obelisk found on the island of Philæ. The latter contained the name of Ptolemaios written with the same hieroglyphs as on the tablet of Rosette, and by the side of it a likewise inclosed group, which he felt justified in considering as expressing the name of Kleopatra, because at the socle of the obelisk a Greek inscription was found, which mentions the king Ptolemaios (Euergetes) and his wife and sister Kleopatra. Now he placed both groups by the side of each other, and compared them, symbol with symbol, which had necessarily to lead him to some result, if his supposition should be established as true that the first group (I), here subjoined, represented the name of Ptolemaios, and the following group (II) that of Kleopatra, because by a fortunate accident the names of Ptolemaios and Kleopatra contain the same five letters.

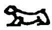
I

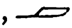


II



The first picturein the name of Kleopatra, a triangle, had to represent K, and could not be looked for in Ptolemaios, where it is indeed not found.

The second sign,  a lion, had to signify *l*, and was actually found as the fourth character in the name of Ptolemaios.

The third sign,  a rush or reed, had to be read as *e*, and was found double in Ptolemaios, where the Greek as (*ai*) was to be looked for.

The fourth sign, a cord with a noose, was in accordance with that previously found as the third character in Ptolemaios.

Just as correctly, the almost square-shaped rectangle which, at the fifth place of the name Kleopatra, had to represent *p*, was met again as the first sign in Ptolemaios.

The sixth letter in the second name, an eagle, had to be sounded *a*, and could therefore not be expected to occur in Ptolemaios; it was, however, in confirmation of the supposition of the decipherer, found as the last sign of Kleopatra.

The seventh sign, a hand, had to be pronounced *t;* in the name of Ptolemaios another *t*, was found in the shape of a semicircle , and this might have misled the decipherer, had he not anticipated the possibility that one sound might be represented by various signs, and correctly concluded that the semicircle at the end of the name of the celebrated queen, which he really also found at the end of other female names, was intended to represent the coptic feminine article, and was pronounced like the hand at the seventh place in Kleopatra.

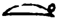
The eighth sign , a mouth, had to signify *r*, and was not found in Ptolemaios.

As the ninth letter the ancient writer has, as mentioned before, another eagle, thus representing the *a* in the middle and at the end of the name by the same sign.

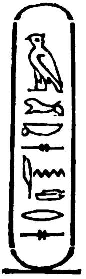
The semicircle after the eagle is, as stated, the feminine article, which, in the coptic language, is ⲧⲉ (te). We met it already as *t* in the second place of Ptolemaios.

Thus no sound in Kleopatra remained undemonstrated, while in Ptolemaios the fifth and eighth sign required confirmation, although it was self-evident that the fifth could not be anything but *m;* the eighth nothing but *s*.

Thus 11 letters, and inclusively of the article 12, had correctly been identified, and all that remained was the experiment to try and decipher other known proper names by their aid.

Champollion directed his attention in the first place to the name Alexander, (Alexandros,) which he believed to have discovered in the great work published by the scholars accompanying the Napoleonic expedition (*la description de l'Egypte*), found the pictures of the eagle, lion, hand, and mouth, in their correct places, to represent the letters *a*, *l*, *t* and *r* respectively, and was now justified beyond doubt in considering the sixth hieroglyph, the zig-zag line, as representing the *n*, in the third sign a bowl  with an ear, for another version of the triangle occurring in Kleopatra, to represent *k;* the fourth a bolt , as a substitute for the chair-back , representing the *s* in Ptolemaios, and thus to explain that one and the same sound could be represented by various pictures. The correctness of this observation has been proved, for the hieroglyphic system of writing possesses indeed a number of signs of different shapes and equal phonetic value, the so-called homophonous signs, yet their number is in the texts from the good old time of hieroglyphic writing much less than was originally supposed, under the erroneous impression caused especially by the Ptolemaic inscriptions, which admit-

III.



ted into the ancient plainer style of writing all kinds of unjustifiable new elements of an ornamental character.

Champollion thought furthermore to be justified in laying down the law, that every so-called letter-hieroglyph represented the sound with which the name of the object commenced that was originally designated by it. Thus the eagle and the bulrush had represented *a*, because the former in the coptic dialect was called axom, the latter ake. Both commence with *a*, as the coptic word for mouth, ro with *r*; the hand, tot with *t*; the lioness, laboi, with *l*; the owl mulai with *m*. There are more examples of this kind to be mentioned, and it is likewise probable that the law laid down by Champollion was decisive in the choice of the pictures to be introduced for representing sounds. Yet we can to-day determine with as little certainty which was the original name underlying the type of every single phonetic hieroglyph, as it is possible with reference to the Hebrew alphabet to point out the real objects which the original shape of its present characters may have resembled at some previous time.

Important and numerous are the details which found their explanation by the tablet of Rosette, but their decisive significance lies in their disposing forever of the error that hieroglyphic writing was merely ideographic, and in raising to a certainty the supposition that it might contain phonetic elements. To be sure the first decipherers had still the task before them to explain the relation between the phonetic and ideographic elements, and thus it came about that by the side of the slowly progressing inductive method represented by Champollion and his disciples, some *new* principles of deciphering could be suggested, which, however, like everything false and spurious, were soon buried in oblivion. How the erroneous suggestions of such scholars as Klapproth, Sickler, Seyffarth, and others, have been refuted, and how the system of hieroglyphics in all its elements gradually and in its smallest details has been recognized with certainty, we cannot here enter upon. Only the result of the almost accomplished work can here be given; we say of the *almost* accomplished work, for since the discovery of the decree of Kanopus, found by Lepsius in 1866 at Tanis—a much more extensive and better preserved inscription in two languages than that of the tablet of Rosette—it has been proved to evidence that Egyptology is everywhere proceeding in the right path. We should be able to understand this decree *without* its Greek translation less perfectly than *with* it only in unimportant details.

How the hieroglyphic system of writing originated can only be conjectured. We meet it in the most ancient inscriptions as something entirely finished. Not a single specimen is left from the time of its origin; yet the ideographic elements are no doubt of a more remote origin than the phonetic ones, for, as the child expresses his thoughts by gestures before he is able to speak, so nations use picture-writing before phonetic characters.

The finished system of hieroglyphics, as exhibited in the literary legacy of the ancient Egyptians, consists of ideographic and phonetic signs. The former are divided into *figurative* and *symbolical* ones, of which the former represent the object *itself* that is to be produced; the latter in an indirect manner the idea that is to be communicated. Thus an ox would figuratively represent an ox, while a contest would symbolically be represented by arms with shield and club. In the finished system the ideographic element is decidedly in the service of the phonetic one. Signs for sounds and syllables command the whole, and thus it seems at the first glance inconceivable why the Egyptians, after language among them had once become the basis, and letters the indispensable elements of writing, had not thrown overboard the whole ballast of ideographic and phonetic characters, and been satisfied, like modern civilized nations, with the 24 simple characters of the alphabet.

The reasons for this phenomenon, we think, can easily be understood; for in the first place the conservative sense of the Egyptians shrank from touching the ancient sacred system of writing which, according to the teachings of their priests, a God, Tauti or Toth, Hermes, the thrice great one, had invented; in the second place, picture-writing, by a simplification to only 24 characters, would have lost that variety which, as we saw, renders it so well adapted to decorative and ornamental purposes; and, in the third place, any simplifier of the sacred style of writing would have acted contrary to the sense of the priesthood, who taught the people the highest matters never in plain, intelligible words, but from principle in mysterious disguises mostly of a symbolical kind. The layman was permitted only to have a suggestion of what the initiated were privileged to see and know.

These reasons prevented a simplification of the style of writing; but we can also find those causes which produced the various elements of the system, and secured to it such an extraordinarily long duration; nay, we assert that hieroglyphics were uncommonly well adapted to the written representation of the Egyptian language, for in all departments of intellectual life the Egyptians show an extremely objective conception. As they try to illustrate all processes in nature by a personification of matter, and of the forces which put it in motion, so they also confined themselves in the department of art to the sensual world. Similarly they proceed in language, in which here, as among other nations, the popular manner of seeing and conceiving that prevailed at a certain time was, if we may use this expression, concreted and fixed. Linguistic expressions may be called the "outside of conception," and as the manner of conception of the ancient Egyptians was preëminently objective, so also its outside, language, became necessarily so, not less than the expression of the latter, writing, which here, easier than anywhere else, can be found to have originated in the innermost peculiarity of language.

Without here entering into any further details, we trace to these peculiarities the appropriateness of hieroglyphics for the language which they are to preserve. They introduce syllables and letters, to which, for the sake of greater clearness, determinative signs are added, which indicate the generic idea to which the expressed word belongs. If the latter occurs very frequently, the writer is generally satisfied with drawing a picture that is usually like the determinative sign added to its phonetic representation, which thus represents the word figuratively or symbolically. The latter, *e.g.* if for the word *age*, a stooping man, leaning upon a staff; for the word *night*, the heavens with a star, are employed.

The art with which the written characters are symmetrically arranged is frequently as remarkable as the choice of pictures. Writing was really an art, not a mere proficiency, so that a hierogrammatist, on his tomb that is preserved at Paris, could justly boast of having known all secrets of the sacred art of writing. The disciple of this art had many difficulties to overcome, and the teacher had to be strict; for it is said, in a papyrus, "the pupil's ears are on his back; he listens when he is beaten." But the social position of a skilful writer was a particularly privileged one; his profession was preferred to all others, even that of the warrior. It is said of that they easily became friends of the Pharaohs, and rich and powerful; and at another place, "that there is none among them who did not receive dainties from the king's table." Royal secretary is one of the highest honorary titles, surpassed only by that of an *actual* secretary of his majesty.

We are at the end. When Champollion died, in 1832, at the age of 43 years, he left the manuscript of a rich grammar, which to-day, no doubt, needs in its details many corrections and supplementary additions, yet in its method is still unsurpassed, correct in its foundation, and therefore valuable for all times. Chateaubriand gave expression to the admiration due to the works of the founder of Egyptological science in the beautiful and remarkable words: *Ses admirables travaux auront la durée des monuments qu'il nous a fait connaitre*—(his admirable works will in their duration equal the monuments with which he has made us acquainted).

Wishing to be just towards all, we cannot well dispute to the French the honor of having been the first scientific decipherers of Egyptian hieroglyphs. After them, German scholars, always aided by the industrious and successful coöperation of their restless neighbors, have perhaps furnished the largest contributions towards furthering Egyptian linguistics and archæology.

If we are asked, in conclusion, whether the newly-won insight into the system of hieroglyphics promises to bear as rich truits to humanity, as we seem to be justified in believing, according to all that the Greeks relate of the wisdom of the Egyptian priests, we feel able to answer this question *conditionally* in the affirmative. Conditionally, we say, for in spite of the bombastic language of the Egyptians, overloaded with metaphors and symbols, the intellectual property of mankind has no doubt gained many useful additions through it, which, however, only in a few departments, especially such as those of history and linguistics, have been unconditionally great and important.

The history of mankind was extended by thousands of years through the deciphering of the hieroglyphs, which threw a new light upon portions of the world's history that before lay in obscurity, and was especialally applicable to the explanation of biblical literature. The ethical and metaphysical writings are not without important passages, especially such as have bearing upon the history of religious philosophy. The theological works are of high interest for comparative mythology, though otherwise appearing as monstrous, exaggerated, and repulsive. The inscriptions of the laboratories and of the papyri, relating to medicine, are certainly more serviceable to the history of chemistry and medicine than to these sciences themselves. The astronomical statements can be of service only to retrospective astronomers. What little there is preserved of mathematical writings contains matter more interesting than important. Works of fiction are highly attractive, but less frequently by their occasionally no doubt astonishing beauty, than by their peculiarity and remarkable analogies with later products of similar kind among other nations. In regard to linguistics, the deciphering of hieroglyphs obtains a daily increasing importance, especially after the decree of Kanopus has established the exactness of previous attempts at deciphering, and after methodical, grammatical, and lexicographic works have enabled every philologist to study the old Egyptian like any other language.

MINING AND METALLURGY.

[This Department is under the editorial charge of THOS. M. DROWN, Analytical Chemist and Consulting Metallurgist, Philadelphia.]

THE engineering and metallurgical world are still earnestly occupied with the discussion of the subject of steel. In the almost hopeless confusion surrounding the subject, as to composition, mode of production, properties and uses, the question naturally arose—What is steel? The answers called forth were many and various, but they mainly served to exhibit the intricacy of a subject which is so many-sided that a comprehensive definition is well-nigh impossible in the present state of our knowledge. A definition would, indeed, be very convenient for purposes of classification, could we agree upon one; but there is, at the present day, a greater need than a cleverly-worded formula. The engineer wants to know what are the uses and properties of steel, and the metallurgist wants to know how to make steel uniform and reliable in quality.

Although we might call this a "steel age," it is nevertheless a fact that where the preparation of a definite quality of steel is required for a special purpose, the steel-maker has to rely on tentative experiments, and the engineer to carefully test all the material furnished him. If the case were simply narrowed down to making hard or soft steel, no particular difficulty would be encountered, but in construction we require to know not only hardness, but toughness—not only strength, but elasticity. These are independent factors, and require to be separately determined. It is not to be wondered, therefore, that the engineer reproaches the metallurgist on the imperfect condition of his art. Where shall we seek the remedy? We must not lose sight of the fact that the preparation of steel of definite and uniform properties is doubly difficult: first, owing to lack of precise knowledge of the effect different substances exert on steel, and second, the effect of different physical treatment.

In a recent address before the British Association, at Bradford, Mr. Barlow insisted on the necessity of mechanical tests to determine the adaptability of any given steel for a special purpose, and such tests are certainly indispensable if we are ignorant of the nature of the material with which we are dealing. But it is thus tacitly implied that steel, as it occurs in the arts, is necessarily an irregular and non-uniform product, and that testing and sorting must always supplement the making and casting of steel. That such irregularity is the rule at present, must be admitted, but that the steel manufacture is not to grow out of this stage of uncertainty, we cannot concede.

What we now need, as Mr. A. L. Holley pointed out in an able paper read before the American Institute of Mining Engineers, at Easton, in October, are close and accurate analyses of steel, in connection with mechanical tests. Simple testing is conclusive for the samples submitted, but it adds nothing to our knowledge of the properties of steel in general. Let it once be settled what are the effects of carbon, phosphorus, sulphur, etc., on steel, alone, in combination and in varying amounts, then steel-makers will be able to furnish a steel of any desired quality to order. In spite of numberless analyses of steel, the fact remains that we are unable to predicate physical properties on chemical composition; not but what chemical composition, when rightly interpreted, is a sufficient basis for this purpose, but because the known facts are deplorably deficient. The subject is a large one, and one that can only be settled by long and painstaking investigation.

The need of accurate chemical analysis is almost as great in the case of pig iron as in steel. This need is now fully recognized in those cases where the pig iron is destined for the manufacture of steel, and no one would, at the present day, think of using pig iron of unknown composition for the Bessemer process. But, when we come to use cast iron *per se*, chemical analyses afford us but small assistance in determining its physical properties. The difficulty is not inherent in this case any more than it is in steel—it is merely a lack of data. In the preparation of castings of pig iron the most diverse qualities are called for. In one instance we want hardness; in another, tenacity; and, again, we want both qualities combined; or a great fluidity of the mass of molten iron may be called for, irrespective of hardness or strength. Cast iron has as great a range of properties as has wrought iron or steel, but its use is often debarred, owing to a lack of precise information regarding its nature and composition.

In those cases where the greatest strength and toughness are required, experience has shown that the iron must be produced from the purest ores and fluxes, and smelted with charcoal with cold-blast. Yet it is highly probable, did we know the connection which undoubtedly exists between the chemical composition of the iron and its physical characters, that we would be able to make an iron equally strong with coke or coal with hot-blast. The following are analyses of pig irons that have been used for ordnance, in Sweden, Austria, and this country. The difference is sufficiently great to prevent any attempt at generalization:—

	Swedish.	*Austrian.*	*American.*
Graphite	2.05	2.416	2.92
Combined carbon	1.41	0.936	1.32
Silicon	0.48	1.671	1.58
Manganese	0.25	3.080	0.91
Sulphur	0.13	0.016	0.07
Phosphorus	trace	0.062	0.14
Aluminum	......	....	0.03
Calcium	......	....	0.14
Copper	trace	0.100	0.06
Cobalt	......	0.083	0.08
Chromium	......	....	0.11
Magnesium	......	....	0.05
Titanium	......	....	trace
Iron	95.68	91.636	92.45

In the case of cast iron, there is, it is true, another question to be considered besides the direct determination of the chemical constituents, and that is the condition of the carbon. The amount of separated graphite is, in part, dependent on the composition, but it is also dependent on the rapidity of solidification. Here is another point of great interest, and one about which little is known—viz., the effect on the strength, toughness, etc., of any given sample of iron, by gradual or rapid cooling, or of long annealing. In the process of making cast-iron car wheels, an iron is required that possesses strength and toughness, and that will also "chill"—that is, be rendered white and hard by sudden solidification. What are the substances that give the iron this property, or what are the substances that destroy it, it is not possible at present to say with any definiteness. Here, as in the previous case, we have to fall back on pure ores, charcoal, and cold-blast.

We do know enough, however, to indicate plainly that a solution of all these questions is to be found in patient chemical investigation. The subject is one of the greatest complexity, and it is to be hoped that competent hands will take hold of it.

——"THE Reports of the Inspectors of Mines of the Anthracite Coal Regions of Pennsylvania, for the year 1872," has recently made its appearance. It includes reports from the inspectors of the Pottsville, Ashland, Shamokin, and Luzerne and Carbon County districts. The reports embrace descriptions of each colliery—its extent, number of employés, character of ventilation, and general details of management. They give, moreover, in tabular form, a full account of all casualties, with nature and extent of injuries. The inspectors were appointed under the act of legislature of March, 1870, providing for the safety and health of persons engaged in coal mines. Although the selection of persons to fill the important positions of inspectors may not have been in every instance judicious, and the reports furnished not all that could be desired, yet the fact that there are inspectors, whose business it is to see that the requirements of the mining law are complied with, is a matter for thankfulness. These reports would be valuable if they merely served to show the immense mortality connected with coal mining—a mortality dependent, in a great measure, on ignorant or reckless management. To the general reader, however, these volumes are mainly interesting, for the report of the "clerk of the mining district of Schuylkill," who was appointed under an act of legislature of April, 1870, entitled "An act for the preservation of the records of the inspectors of mines, etc." The incumbent, Mr. P. F. McAndrew, is not content to submit to the public a dry compilation of facts and figures, but makes use of his opportunity to enlighten the world at large on sundry matters more or less remotely connected with mining—as social and political science, chemistry, physics, history, and the nature of things in general. In the volume before us he has not been, perhaps, so happy in the selection and treatment of subjects as in the two volumes previously issued by him, but still he is sufficiently entertaining to render the book worth reading. We turn with relief from the tedious tables, giving lists of deaths, wounds, widows, orphans, etc., to Mr. McAndrew's pleasant treatises, for the "clerk of the mining district of Schuylkill" is an unconscious humorist. Josh Billings and Artemus Ward might well envy his skilful manipulation of words and sentences. Speaking of colliery accidents, he writes:—

"This melancholy fact forcibly attracts attention to the inquiry: To what proportion of these accidents preventable causes may be due, and how far from them are the dangerous nature of the miners' occupation inseparable? In most cases, mine accidents scarcely receive a passing notice, except in the vicinity of a serious disaster, where, for a time, all is inquisitive confusion, often enveloped in palliative excuses and speculative opinions, as the result of accident or irresponsible causes among the thousands of workingmen, as well as higher agencies, until of late."

In another place, speaking of carbonic acid in mines, he says:—

"Eight per cent. of carbonic acid gas is dangerous to respire. It acts like poison, and to prevent its effects from being fatal, persons asphyxiated (suspended animation) by this gas, should remain in it for a short time."

Had we space, we might continue to quote similar lucid passages; but, while we derive amusement from reading such literature, we think it, under the circumstances, high time that it is put a stop to. We have now three of these reports; and if carefully collected data are to be regularly associated with such nonsense, we cannot expect that any dependence will be placed even upon the statistics.

——CHIEF JUSTICE MCKEAN, of Utah, has recently made two important mining decisions, which will be universally approved for their straightforward justice. The Engineering and Mining Journal of November 4th gives the following account of them: "The first case was that of the Highland Chief *vs.* the Prince of Wales and Antelope titles in Big Cottonwood. The principle involved is one which deserves attention, namely: that the patent to mining property granted by the United States is merely a quit-claim on the part of the United States, and cannot destroy the previous existing equities of the case. In this instance of two parties applying for patents, the party making the latter application, and having the younger location, received its patent first; and the court holds that 'the younger patent, in which are merged the elder equities, prevails over the elder patent, founded upon the younger equities.' Moreover, the rights of the earlier locaters, acquired under local and former congressional laws, are expressly recognized by the act of 1872 (sec. 16); and 'neither the register nor the receiver of the local, nor the commissioner of the general land office, nor the secretary of the interior, nor the president of the United States, nor all of them together, have authority to take from the defendants what congress has conceded to them, and give it to the plaintiff.'

"The second case was that of the Wyoming patent, in the American Fork mining district, which was applied for March 20, 1872, and issued September 30, 1872, there being at that time no adverse claim on file at the general land office in Washington. A protest had, however, been lodged at the land office in Salt Lake City, June 18, 1872, which was 'overlooked' by the register, and was subsequently forwarded by him to Washington, October 17, 1872, several weeks after the patent had been issued. The patent is, of course, null and void, having been illegally issued, in spite of the protestant's right to be heard. But the question is: Who shall take proceedings to recall it? The United States has done this; and Justice McKean, in overruling the demurrer of the defendants (holders of the patent), declares it to be the duty and the right of the government to reclaim the patent, and, if necessary, to force its return to the land office, that the whole case may be reopened and properly adjudicated."

——CURRENT technical literature in the department of metallurgy rarely amounts to more, now-a-days, than the description of new and patented inventions; and, even in this limited field, it is seldom that we find instances of any marked intelligence, to say nothing of genius or careful investigation. The present age, in the arts, may be called one of a general diffusion of superficial knowledge. Popular scientific and technical lectures and treatises are greatly in vogue, and supply a deeply-felt want. An unavoidable consequence of this "little knowledge" is the rediscovery of legions of well-known facts, and the reinvention of numberless machines. Looked at from an an abstract point of view, this fact is encouraging, as it is a sign of increased mental activity and self-education on the part of the masses. It has, however, an annoying side, which is a fair subject for complaint, and that is, that the majority of the technical journals of the day publish a mass of crudities, and even absurdities—often without comment, but still oftener with an approval that savors of gross ignorance—or something worse. An instance in point is the account given of the "discovery of codorus ore," which still serves to fill up many a gap in the columns of our contemporaries. We may, perhaps, in this particular instance, be judging harshly, for the article in question is so excessively absurd that its insertion may often be due to a keen appreciation of the ludicrous on the part of an editor.

In contrast to this state of affairs, it is with pleasure that we notice a series of articles now being published in Engineering, on the "Iron Manufacture at the Vienna Exhibition." The articles are anonymous, but are evidently written with a view to subsequent publication in book form. The author does not merely give the reader an enumeration of the articles exhibited, but prefaces each subject with a clear and concise resumé of the state of the manufacture at the present time. To take one instance: the number for October 17th contains an admirable description of granular and fibrous irons, what they are, how produced, and the objects for which they are best adapted. The author helps to explode the notion that "good fibrous iron" is the aim and end of iron-making, and shows that for most purposes of construction granular iron is to be preferred, and that fibrous iron has its principal use in objects that have to stand impact, as armor-plates. It were devoutly to be wished that we could oftener meet with articles showing equal care and intelligence in their preparation.

——THE proposition originally made by Mr. J. Blodget Britton, of Philadelphia, and strongly urged by prominent ironmasters throughout the country, to have a commissioner appointed by the centennial commission to collect, analyze, and arrange the iron ores of the country, has at last received a definite answer from Mr. D. J. Morrell, chairman of the commission. He states, briefly, that it would be impracticable for the centennial commission to undertake this work, that it does not belong to its sphere, and that, should an exception be made in favor of the iron interests of the country, it would give good ground for complaint by other industries. The whole subject has now been passed over to the American Iron and Steel Association. This is eminently just and proper. Admitting the great importance of a classification of the iron deposits of the country, as complete as our present knowledge and the somewhat limited time will permit, it is but fitting that the iron men of the country should supply the funds for the work, and contribute the results to the centennial exhibition. Leaving out of consideration the immense advantages that would result to those immediately interested in the iron business from such a collection, which would of itself more than pay for the expenditure involved—to put the matter on a mercenary footing—one might expect that there would be enough public spirit and patriotism on the part of ironmasters to make this contribution to our centenary. It should be a matter of honor and pride with them, and we hope they will show their appreciation of the subject by subscribing liberally and promptly for this object—irrespective of the price of pig iron.

——THERE are two "schools" of the Bessemer process in Austria—the Tunner and the Hall. The first—in practice at Neuberg, Turrach, Heft, and Reschitza—is characterized by the use of a superior quality of pig iron, generally taken direct from the blast furnace, and blown until the desired degree of hardness is obtained. Spiegeleisen is not employed, but in its place a gray pig iron is sometimes used, in order to guard against possible "shortness." The Hall school—in practice at Gratz, Wittkowitz, Ternitz, and Zeltweg—follows closely the English method of remelting the pig iron in a cupola or air furnace, complete decarburization, as indicated by the spectroscope, and recarburizing by spiegeleisen. The latter system is perhaps better adapted for rapid working and large production, but has the drawback, as compared with the former, of requiring the costly spiegel.

It has been suggested by Kupelwieser that white iron might be used in the Bessemer process, by the employment of hot-blast, and, perhaps, a mixture of oxygen gas with air. Hot-blast has been tried, it is said, and found, in general, to give no advantage. It would be a point of great interest if it were found that white iron might be rendered available by its use. The employment of oxygen gas may well be considered visionary, though the economic objection may be expected to disappear, if new processes for its manufacture continue to cheapen its production in the future as they have in the past. Kupelwieser suggests, in the article from which we quote (originally published in the *Oesterreichische Zeitschrift* of last year, and reprinted in a recent number of the *Berg und Hüttenmännische Zeitung*), that phosphoretted pig iron may, perhaps, be used in the Bessemer process by over-blowing, removing the slag containing a large part of the phosphorus, and then recarburizing the mass by white iron, free from phosphorus, in a Siemens furnace. It is said to have been noticed that over-blown iron is comparatively free from phosphorus, owing to the basic slag formed by the oxidation of the iron.

——THE most important contribution to mineralogy and geology that has been made for some time is the results of an investigation by Dr. F. A. Genth, of the University of Pennsylvania, on the occurrence and alterations of corundum. By careful collection of specimens from many localities, and by laborious mineralogical and chemical investigation, Dr. Genth has traced the changes which corundum undergoes in its transformation into other mineral species. The conclusions arrived at are summed up as follows: "That, at the great period when the chromiferous chrysolite-beds (in part subsequently altered into serpentine, etc.,) were deposited, a large quantity of alumina was separated, which formed beds of corundum; that this corundum has subsequently been acted upon, and thus been changed into various minerals, such as spinel, fibrolite, cyanite, and perhaps into some varieties of feldspar—also into tourmaline, damourite, chlorite, and margarite; that a part of the products of the alteration of corundum still exists in the form of large beds of mica (damourite) and chlorite, slates or schists; that another part has been further altered, and converted into other minerals and rocks, such as pyrophyllite, paragonite, beauxite, lazulite, etc."

——MR. FRIEDRICH ASTHŒVER, engineer of Witten, Prussia, proposes to combine hard ingots or blocks of steel, in the process of casting, with laminæ of soft steel or wrought iron, in such a manner that the latter, in undergoing the rolling process, may assume an internal position; thus combining a certain amount of elasticity, ductility, and toughness in the interior, in resistance to fracture, with a hard exterior to undergo wear and abrasion.

——MR. THOMAS HAMPTON, steel manufacturer of Sheffield, proposes to cast armor-plates of Bessemer steel. A tough, fibrous iron has always been considered a *sine qua non* in armor-plates. We are therefore surprised to hear anyone suggest using cast plates of Bessemer metal, "which may be thoroughly or partially decarburized at will, according to circumstances."

——A RECENT discovery of gold has been made in the immediate vicinity of Rutland, Vermont. It is said that the sands of Mill river yield ten cents per pan. Prospecting is going on with vigor; but Vermonters are used to gold excitements by this time, and will probably take their good luck calmly, and keep cool.

——THE following is the production of the Port Henry (Lake Champlain) iron mines for the last five years: 1869, 129,400 tons; 1870, 164,200 tons; 1871, 184,100 tons; 1872, 292,000 tons; 1873 (to September), 259,300 tons. Total, 1,029,000 tons.

INSURANCE.

INSURANCE department reports, giving the condition of companies at the close of 1872, have, in their issue, straggled through the year 1873—those appearing last but repeating in the larger portion of their essential contents what had before been made public by the reports earliest out. We presume that the heads of departments appreciate the fact that the direct commercial value of the statements is depreciated in proportion to the elapse of time between date of returns and date of printed issue (in which time the position of many companies may have materially changed); but so long as each State bureau has to go over so large a part of the entire insurance list of the country, such protracted non-appearance is in a great degree unavoidable, and especially as past experience is teaching that *more time* must be given to the inspection of each company. There is, however, a remedy for this defect, and it is one conducive to an improved and advancing State supervision, apart from the object immediately aimed at—and that is, that his own State companies should be the first care of each State official, and on completion of his work, with respect to these, he should make prompt publication of the condition and business of such State companies, leaving State-authorized outside companies for such subsequent publication as may be necessary. This would move in harmony with the admission of non-State companies upon certificates of their respective States, and make such certification more worthy of reliance, as well as of earlier receipt. For, if supervisory ability and law are equal, it is a just inference that a department can arrive at a truer interpretation of the condition of a company upon its own ground, than a distant department can—exclusively local influences being everywhere operative on the fate of such organizations. Therefore, with each State official less diverted, or not in the main diverted from the circle of his most effective action, each distinctive State work will be done better than it is, as well as be done more timely; and the aggregation of such specific State accounts would make a body of supervision not yet, we think, equalled for accuracy of results.

We design this suggestion simply as an immediate practical point to be considered in opening the department work for 1874, not in any way as an advocacy of the limitation of each State supervision exclusively to the State companies. Possibly we foresee what must come from the principle of uniformity in State legislation, but we are not now discussing *any* limitation of the department oversight or authority over non-State corporations. Taking the State bureaux as they are, one with another, or one against another, as being in their respective or successive scrutinies of a single company, tests, confirmations, and criticisms of one another, if what is really the more direct surveillance were yet made principal, and the secondary work of reviewing were left to its own time, place, and proper functions, the distinctive value of each department would be greater than it is. Certainly the chief responsibility for the correct disclosure of the position of a company should rest upon its own State.

——FROM the New York Insurance Age we clip the following, relative to the late National Life Insurance Company of New York: "The character of the business done by the National will materially aid the receiver in a reinsurance of risks, as the medical department was conducted with the strictest care, and considering the circumstances attending previous failures of life companies this year, it is creditable to know that if the management was unsuccessful, it is free from the charge of dishonesty or a wilful breach of trust."

——THE Association of Fire Underwriters of Philadelphia has reached its first annual report, and the body has been in active operation since its organization, October 18, 1872. At the close of its first year, the membership of the association represents 88 fire insurance companies, with a total of $150,000,000 of assets. About coincident with the compilation of a tariff of rates, the Survey department was organized, with Mr. E. B. Merrill as chief, and Mr. J. G. Brittain as assistant; and the intelligence with which these gentlemen have discharged their duties, highly commends their appointment. The tariff, as at first compiled, was revised to harmonize with the facts disclosed under the new inspection of risks, which has given the clearest analysis yet presented of the combustible character of the specially hazardous Philadelphia industries, and resulted in the collection of much significant, practical data. In the first eight months of the Survey department, there was a survey, and rating in accordance, of the following description of risks: 124 cotton and woolen mills, 54 machine shops and foundries, 30 wood-working establishments, 15 printing and binding establishments, 16 railway depots, 14 places of amusement, 19 malt houses, 4 print works, 4 paper mills, 5 chemical works, 3 glass works, 3 sugar houses, 5 meat and smoke houses, 4 oil refineries and warehouses, 5 marble works, 1 oil-cloth works, 1 car works. Besides these 307 large establishments, there were 759 small manufacturing establishments, and merchandise and miscellaneous risks examined, making a total of 1,066 special rates. Many of the larger risks comprise several buildings included under one report. The rates of premium adopted are at once announced to each member, and to the general agent of the National board, at New York. These printed slips or circulars now number 80, and embrace in their contents every variety of ordinary and special hazard. Complete tariffs of every issue in Pennsylvania, those of New York, Boston, St. Louis, Providence, Hartford, and many other prominent localities, are on file in the rooms of the association, and the machinery of the organization works smoothly and harmoniously. Receipts of the association for the year, $10,807.33; disbursed, $10,211.91.

——THE fire and the marine insurance of California, in the year 1872, respectively resulted as follows, on the State business:—

FIRE INSURANCE.

	Amount insured.	*Average premium thereon.*	*Ratio of loss paid to amount written.*
State companies	$ 65,484,932	1.17	0.26
Other-State and foreign companies	134,693,485	1.19	0.36
MARINE INSURANCE.			
State companies	$40,290,362	2.02	1.26
Other-State and foreign companies	13,910,305	1.43	0.90

Commissioner Foard submits a new idea in respect to retaliatory legislation, applying the retaliation only as a State departs from the standard by which it taxes its own companies in order to make greater exactions upon non-State companies. The language of the commissioner is as follows: "In so far as the general laws of California are concerned, the business of insurance, whether conducted by home or foreign companies, is now entirely free from discriminating exactions. Retaliatory section 622 of the political code, however, presents a remnant of the prohibitory system of former years, to which I beg to call attention, in the hope that it may be so modified in its requirements as to be made operative only against exactions by other States upon companies of this State, in excess of such exactions upon their own companies respectively."

This, more directly than the present rule, assails the principle of State discrimination against non State companies; carried out in general practice, it would let the question of taxation rest more nearly upon its own exclusive ground, and remove the small business of petty vengeance from the insurance laws.

——A CONSERVATIVE non-progressive life business can be pursued in England with success. The Friends' Provident Institution is a life company forty years old. Throughout its forty years it has not issued an average of a policy a day—the average being about four a week; yet, with commissions and management expenses together footing up 5.63 per cent. of net income, it has accumulated about $5,750,000 of invested funds, and has divided $3,000,000 of surplus among its policyholders. In the United States, companies carrying on business at such a rate have faded out.

——The annual report of Hon. Joel M. Spencer, insurance commissioner of Rhode Island, bears date of August 15, 1873, and appeared in October. It sets forth that at the beginning of 1872, five of the Rhode Island stock fire and marine insurance companies, "representing one-half of the entire capital of our stock companies, were in a state of bankruptcy and ruin." Eight companies of this class are doing business at the present time, and they show financial position and business as follows:—

RHODE ISLAND JOINT-STOCK FIRE AND MARINE INSURANCE COMPANIES.

Table, exhibiting cash capital, with net surplus over capital, or impairment, and fire and marine risks written during 1872, *premiums received on same, and losses paid.*

COMPANIES.	Cash capital.	Net surplus over capital.	Impairment of capital.	FIRE.			MARINE AND INLAND.		
				Risks written.	Prem's received	Losses paid.	Risks written.	Prem's received	Losses paid.
Atlantic	$200,000	......	$ 9,991	$ 4,630,747	$ 29,086	$167,946	$ 2,591,066	$ 21,460	$ 10,044
City	100,000	$ 6,798	......	4,918,544	62,947	32,604	....	......	......
Equitable	300,000	......	237,112	10,173,814	91,133	65,084	29,937,306	44,324	20,925
Merchants	200,000	......	7,607	15,787,281	170,862	145,106	1,833,210	8,172	1,531
Narragansett	250,000	12,111	......	21,504,653	257,795	365,058	5,497,357	111,396	163,407
Newport	200,000	......	4,593	11,378,060	73,679	36,424	12,376,543	68,669	18,158
Providence Washington	200,000	3,144	......	6,893,161	59,753	78,947	....	......	......
Roger Williams	200,000	9,564	......	1,217,319	929	165	99,619	675	927
	$1,650,000	$31,618	$259,305						

There are, besides these stock companies, twelve companies on the mutual plan, showing cash assets, $737,227; risks in force, $102,938,689; premiums thereon, $930,638. About one-half of the fire risks of the State appears to be insured in these mutual companies. Assessment authorized to pay losses in 1872, $9,291,322. Without endorsing the basis upon which the business of these mutuals is conducted, the commissioner thinks them useful, in the absence of local stock capital, "to retain a large amount of money among our people."

Eighty-eight fire and fire-marine insurance companies transacted business in the State during the year, or some portion of it. The Franklin Fire Insurance Company of Indianapolis, Indiana, and the Rochester German, of Rochester, New York, have both filed copies of power of attorney and other papers, preparatory for the transaction of business in the State; but no person has been authorized under the laws of the State to act as agent for either of these companies.

The amounts insured, with premiums and taxes, of the non-State fire and fire-marine companies compare as follows for the last four years:—

	1869.	1870.	1871.	1872.
Amount insured	$34,070,482 25	$36,592,448 69	$49,787,599 19	$49,468,683 62
Premiums	449,241 95	436,621 56	604,151 22	633,221 94
State tax	8,983 94	8,733 09	12,483 64	12,657 45

Rhode Island had one life insurance company (the Economical Life), which, as our readers are aware, is now defunct. "The charter of the Economical Life Insurance Company," says the commissioner, "seems to have been framed very guardedly as to the rights and privileges of stockholders, without those safeguards as to the rights due to the insured that justice and equity would demand."

Twenty-five life companies of other States transacted business in Rhode Island last year, and the following withdrew during the year: Continental, Hartford Conn.; Germania, New York;

Globe, New York; Metropolitan, New York; National, Chicago, Ill. Number of life policies issued in 1872, 1,012, insuring $2,783,211. Number of policies in force, 5,816, insuring $17,215,267. Premiums received in the year, $797,662. Losses incurred, $197,746.

——THE trial of William E. Udderzook at Westchester, Pa., began October 28, and ended on Sunday, November 9, at 2 P.M., in his conviction for the killing of Winfield S. Goss, June 1, 1873. This vindicates the position taken by the insurance companies, as against the Baltimore verdict, by which Winfield S. Goss was burned to death February 2, 1872, and is an example of "setting a verdict aside," which does not adduce anything particularly favorable to the reliability of legal investigation; but the wonderful detail of the Westchester trial leaves no room for the question to come up: Which of the two verdicts is the right one?

The defence, objecting to two counts in the indictment against Udderzook, the second one—the charge of killing an unknown man—was dropped, and this brought the insurance side of the case directly to issue—upon the prosecution resting the burden of proving that the mutilated remains of a body found in a wood were those of the man Goss, who, long anterior to such mutilation, was otherwise dead—by the record.

The evidence submitted by the commonwealth linked circumstance with circumstance; the story was retold of the burnt Baltimore corpse, with the unlikeness of its teeth with those of Goss; there was also a resemblance, so far as discernible, between the dissevered body found in the wood and a photograph of Goss; then A. C. Wilson was like the photograph of Goss; the clothes and other personal effects of A. C. Wilson and W. S. Goss were alike; further, the handwritings of the two were alike; the men, also, were alike in habits; and the circumstantial identification attained its climax in the testimony of Samuel W. Rhodes, who reported Udderzook as saying of A. C. Wilson, that "he had been lost for a long time, and everybody thought he was dead." Such agreement in identity was explainable by no theory of coincidences, and the defence, in a measure, broke down, though it produced testimony as to the identity of the Baltimore corpse with Goss. Udderzook's sister, who saw Wilson, saw no resemblance to the Goss photograph; witnesses testified against the veracity of Rhodes (counter-testimony by the commonwealth), and the appearance and bearing of Udderzook immediately subsequent to the making away of Wilson were in his favor. The jury—an unusually intelligent, careful, and conscientious one—occupied 45 hours in reaching a unanimous conclusion. When the case was first given to the jury, one-half of the members could not interpret the evidence as being conclusive as to the murder of *Goss*, and, it seems, a further review and sifting increased the doubters to two-thirds. Subsequently, an appeal to the court fot a reading of Dr. Bailey's account of his post-mortem examination of the remains found in the wood, and a call for the letters of Wilson and Goss, supplied the means of removing the obstacles to a concurrent judgment, and a verdict of guilty of murder in the first degree was rendered—a verdict solemnly and tearfully rendered by men who saw no escape from such decision, as it rested upon grounds which were irrefutable.

——THE American Exchange and Review hits "State supervision" the hardest blow yet, in an attempted defence of it. The article is carefully and ably written—so carefully and so ably that, after repeated readings of it, one is unable to discover what is the true attitude of the writer toward the subject discussed. The following paragraph, while professing to tell us what the writer would have, serves admirably the better purpose of telling us just what we have *not*.—*The Chronicle.*

The anti-supervisionists appear to find consolation in our inquiry as to the State relation to insurance, and we do not wish to disturb their felicity or deprive them of any support to their cause which they may find in our views. It was not our design either to smash the State insurance departments or to cover them with eulogy; so, taking no extreme ground, the "attitude of the writer" is not perceivable by the distorted vision of the extremist. Therefore, speaking by the card, we explain: 1st, that, while we endorse the *principle* of State supervision, we condemn many of the practices which have occurred in the application of the principle; 2d, that perversions of such supervision do not justify underwriting in the dark, nor a free field to wildcats; 3d, that State supervision (overlooking) of insurance does not properly imply State interference in the conduct of the business, but that the true functions of such supervision would be best served by a statistical bureau with power to verify the data; 4th, with a better supervision will come better insurance.

——MESSRS. Bryant, McClintock, and Kellogg, professional actuaries, make their report of the assets and liabilities of the St. Louis Mutual Life Insurance Company, October 1, 1873, being the conclusion of their special examination into the affairs of the company. The result reached by them shows assets $5,948,989.37, and liabilities (with 4½ per cent. valuation of outstanding policies) $6,360,279.02; thus disclosing a deficiency of $411,289.65, after the absorption of the capital stock, and not including in the liabilities $64,148.35 of resisted claims (more than four times the amount reported for December 31, 1872,) and including in the aggregate asset value all the asset items. The schedule of assets given for October 1, 1873, we recast as follows:—

1. REAL ESTATE, IN FEE AND LOANS,

(*As valued by the Officers of the Company.*)

Real estate loans	$1,830,811 50	
Company's building (at cost)	631,078 70	
Company's lot (Sixth and Locust streets, St. Louis,)	196,000 00	
Real estate purchased under deeds of trust, forfeited	62,597 86	
		$2,270,488 06

2. PREMIUM CREDITS,

(*As ascertained by the Actuarial Committee.*)

Premium notes (including $10,502.71 cash notes)	$2,248,952 12	
Deferred premiums (net amount)	110,601 35	
Premiums in process of collection and transmission (net amount)	100,410 46	
		$2,459,963 93

3. CASH AND NON-REAL ESTATE INVESTMENTS,

(*As stated by the Officers of the Company.*)

Cash in office and bank	$ 19,391 53	
Stocks and bonds owned by company	240,257 45	
Loans on collateral*	51,000 00	
		$310,648 98

4. ACCRUED INTEREST, &C.

(*Estimates approved by the Actuaries.*)

Accrued interest, including $4,050 accrued rents, computed by company	$109,656 44	
Discounted real estate notes in excess of 4½ per cent. interest (estimated)	135,000 00	
		$244,656 44

5. OTHER ITEMS.

Due by agents	$150,745 19	
Bills receivable*	47,305 04	
Office furniture (half cost)	15,181 63	
		$213,231 86
Total		$5,948,989 37

The liabilities presented offer nothing especially noteworthy, excepting the novelty of not adding the amount of contested claims. Amount insured, including reversionary additions, is given as $44,832,130, being $1,405,805 less than amount reported December 31, 1872. The 4½ per cent. reserve is figured at $6,173,463, which is equal to 13.7 per cent. of the insurances in force, and the analogies of the life business would seem to justify this amount as no understatement.

The fore-named asset total is $565,000 less than the amount claimed December 31, 1872. Bearing on this is the remark by President Lewis: "That the figures contained in it [the investigation report] fail to approximate more closely to those appearing in the last annual statement of the company, can be accounted for only by those under whose direction the last-mentioned statement was prepared." The falling off, however, appears in premium notes, &c., (No. 3 of our classification of assets,) they being $678,000 less; and what the present year may have done for asset growth is not stated.

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* These two items appear together in the actuaries' statement, as follows: "Bills receivable, including loans on collateral, $51,000—$98,305.04." The New York department struck out from the assets of this company's last annual statement "loans on personal security only" to the amount of $149,306.41.

It will be remembered that the removed State superintendent (Selby) asked for an injunction against the company, on the ground that the asset deficiency was $904,955.08, which makes a difference of $493,665.43 between the superintendent and the actuaries; and if we are to consider that the superintendent did the worst he could against the company, we do not know which of the two countings speaks the more in favor of it. According to a growing State department usage (the given data being accepted), the position of the St. Louis Mutual Life might possibly be figured up as follows:—

Assets	$5,948,989 37	Liabilities	$6,360,279 02
Less agents' balances and notes on personal security	198,050 23	Add claims contested	64,148 35
	$5,750,939 14		$6,424,427 37
			5,750,939 14
		Deficit	$ 673,488 23

Such a deficit still falls short of the ex-superintendent's figures, and leaves the data, or the rule of measurement applied, by which his finding may be vindicated (if it can be), to future disclosures.

Mr. Lewis, the president of the company, indulges in the "hope of being allowed to continue business for the present in the States where 4½ per cent. reserve is required, and until the company can be supplied with the additional amount required by their laws." On the vital question whether the company can continue business in Missouri, he and the board of directors "anticipate no difficulty," assigning as the ground of their confidence that, "if the law requiring a 4½ per cent. reserve could be applied to this company at all, it could only be applicable to policies issued subsequent to the passage of the law." In accordance with this definition of the legal status of the St. Louis Mutual Life, a 6 per cent. valuation of policies issued prior to March 10, 1869, was made: this, calling for $737,944 less necessary assets, gives a surplus of $326,654.35 as a starting-point in contending for the exemption claimed.

Believing that, in this matter, the interest of life insurance demands impartial statement, rather than partizanship, and designing neither controversy nor criticism, we make, without comment, this resumé of the position of the St. Louis Mutual Life, as at present exhibited.

Since the foregoing was written, we understand that another of the investigations into this company's position has come to a close—namely, that of the accountant, Mr. Arthur Kempland, employed by stockholders (the Overstolz committee) for the purpose. Mr. Kempland credits the company with $5,954,599 of assets, so increasing the actuaries' asset figures by $5,610; but he augments the liabilities to $6,956,214, being $595,935 above the actuaries' account, and so makes a deficiency of $1,001,615—a yet greater deficit than that charged by Superintendent Selby. The question, What are the policy obligations of the St. Louis Mutual Life? appears yet to await a solution.

Gen. Frank P. Blair, the new superintendent, will prosecute the suit broght by his predecessor, to test the right of the company to continue business under the Missouri insurance law and its charter.

——WE believe that the figures of the Chicago loss of the American Exchange Insurance Company of New York were finally fixed somewhere about $58,000. Of this sum, $28,875 were adjusted at close of year's business. Now comes this telegram from Chicago: "A verdict has been rendered against the American Exchange Fire Insurance Company of New York, in the case of a policyholder who, after the great Chicago fire, compromised his claim of $1,000 against them for $600, on representation of the agent of that company that they could not pay more, but this afterwards found to be untrue." An appeal to the Supreme court allowed. This case (Samuels against the company) was made the test of other suits against the Commerce Fire Insurance Company of New York.

——MR. WILLIAM BARNES renews his project, which was started in 1868, to secure a uniform notation in the mathematical formulæ of life insurance, designing thereby a fixed symbolism, to be not only of national, but international application—unity being named as 1 simply, and not in connection with any national money of account. At pressent, however, such notation tends to develop itself nationally, many of the signs being the initial letters of the names of the quantities indicated, in the language of those employing them. Mr. Barnes has issued proof-slips of a notation which he proposes for adoption in its completed state, in the introduction to the Valuation Tables of the New York insurance department. In this, Dr. Farr's characters are discarded, excepting in what relates to the Commutation Columns, and the arrangement of the London Institute of Actuaries made the basis otherwise. The new system starts with Ax as the mark of the value of an Assurance of 1 on life x, limits a to the expression of Annuity values, is distinguished by the use of prefixes in lieu of former suffixes, somewhat lessens the supply of Greek characters, and though largely employing subscripts, is pronounced available for those who prefer to go on line with the functional form.

As a rule, American actuaries incline to adhere to Farr. A few years ago, the body of German actuaries, in proposing a fixed standard of notation, remarked: "Every new work which touches this branch, requires a new study of its notation, and this study becomes the more difficult as a small collection of symbols are employed with constantly changing significations." Any reform which serves to dispel the mystery made to darken a simple matter, deserves approval, and the layman receives a hint of the importance of the subject when he appreciates in how large a sense actuarialism is—notation.

——THE Carlisle table has got into court in Iowa, for a novel purpose. A child, two years old, was run over on a railway by a passenger train. The father brought suit, and leave was asked to introduce the Carlisle table to show the probable duration of the child's life, with a view to claim damages for such a period—the child being considered as able to acquire an estate in the future. Such showing was prohibited by Judge Brannan, and the jury returned a verdict for $750; considering simply the value of the child's services during minority. Being carried to the Supreme court of Iowa, the showing prohibited in the court below was admitted, and the jury here returned a verdict for $4,750, based upon the life expectation according to the table, as the loss which the probable estate of the deceased had suffered from such death; the estate commencing at 21 years of age, and growing during the average duration of life from that age. Such, at least, is the case as we have been able to glean from the reports concerning it. The railroad company will appeal to the Supreme court of the United States, to reach the final test of such lawing on life probabilities.

——IT would seem scarcely possible for the National Life Insurance Company of the United States of America to have a month of severer trial in all the coming years, than that of last October. The suspension of the great banker, identified with the history of this company, had been made the ground of all imaginable conjectures, and this was followed by the failure of the National Life, of New York, and, in the usual happy way some people have of mixing things, one National was confounded with the other, which evinced a wonderful knowledge of the difference between the two companies. The management was, however, equal to the emergency thrust upon it. By the excitement the company gained new attention, people were impelled to additional scrutiny, the company's record was made clear to the world, and a fresh impetus was given to its business. Result—$1,115,592 of new insurances, being the greatest acquisition of new business in any month, save one, since July, 1869.

——DEATH removes from the Philadelphia insurance circle Robert Oliver Lowry, who died in the city of his birth at the age of 55. Mr. Lowry's connection with the insurance business was a long one, beginning after the spirit of youthful enterprise had carried him to South America, and overland to California, while the "Arganauts of '49" were sailing thither. His specialty was marine insurance, and he was secretary of the Merchants and Mechanics, of Philadelphia, a marine and fire office, before the panic of '57. After the winding-up of this company, he continued in the business as an agent. A brave spirit, a generous, manly nature, endeared him to a large circle of friends, and we share in the wide feeling of regret that attends his departure.

——A MONTHLY bulletin is now issued by the National board of fire underwriters as a periodical synopsis of the work of the executive committee. The first issue records the following resolutions, modifying rates:—

Resolved, That when benzine or naphtha, patent or gutta-percha cement, or either of them, is used in boot or shoe factories, a charge of one-half of one per cent. additional rate will be made; but no additional charge shall be required for the use of gutta-percha or rubber cement in such boot and shoe factories as have a condition in each policy that no more than a pint of cement shall be kept in the factory at any one time; and all policies on the risk named, where such articles are not in use, shall have inscribed therein a clause expressly prohibiting their use.

In response to the request of the New York State board, at the annual meeting held July 15, that in all forms of policies on manufacturing risks, *fixtures* be separated from *tools*, and be written either with fixed or movable machinery; and that *furniture may be insured* with *tools*.

The New York State board, submitting a reduction of 25 per cent. on lumber risks written with the average clause, it was resolved, "That the New York State board was directed to modify the resolution, so as to allow a reduction of 20 per cent., instead of 25 per cent., on present rates on lumber yards when the co-insurance or average clause is made a part of the policy."

Pork Houses.—When privileges are used beyond four months of the year, an addition to the regular annual tariff for such class of risks must be made, at the short rate of one per cent. per annum. Fractions of months to be charged the same as whole months, and policies to limit the privileges in all cases to four months, when this extra rate is not charged.

Tobacco Stemmeries.—D class, having metal or slate roof, deduct 50 cents.

——THE Chronicle tells this story: "While Goss was hiding in Newark, under the assumed name of Wilson, he was known as an idle, good-natured, social fellow, without visible means of support, and yet always supplied from some unknown source with sufficient money to provide for his actual wants. In one of his confidential moods, he proposed to his room-mate that they two enter upon a speculation sure to be profitable and safe. The room-mate was to furnish money enough to pay the quarterly premium upon $70,000 of insurance on the life of Wilson, who said that he was a good risk, sure to be accepted. A woman was to be found to personate the widow of Wilson, and the scheme was to be carried out as follows: He, Wilson, was to procure a body, as like his own in size, &c., as possible, from the Bellevue hospital in this city. This was to be conveyed to some house in the outskirts of Newark, hired for the occasion; Wilson was to be the last seen in it, just before it was fired; the charred body was to be found in the ashes, claim made upon the insurers, and the spoils divided. The man to whom this proposition was made, incredulous of the success of the scheme, asked, "But what if the companies refuse to pay?" To which Wilson (*alias* Goss) replied, and mark the reply: 'They must pay. I've tried it once. *A jury is sure to make them pay!*'"

——MR. GEORGE D. CAPEN, well known as one of the oldest underwriters of St. Louis, has recently removed to new quarters in the building of the St. Louis Mutual Life. The area of the new office is 31 by 40 feet, and the beauty of the interior architecture, combined with the elegance of the appointments, makes it one of the handsomest of the agency bureaux in the country. The whole fitly symbolizes the extent and character of Mr. Capen's business. He represents about $17,000,000 of fire assets, and his list embraces some of the very first fire offices of the country, besides the North British and Mercantile, of London. To enumerate the the Home of New York, the Insurance Company of North America, and the Hartford Fire, as heading the list of companies of which Mr. Capen is the authorized representative, stamps his position in St. Louis insurance as at about the highest attainable point.

——SADLY we record the death of Edward A. Stansbury, once conspicuous in New York insurance affairs—a man of brilliant and vivid intellect, of sincere and earnest purpose, and of upright life. He was born in New York city in 1811, and died at his residence, in New Jersey, early in November of this year. Before becoming an underwriter, he was editor of a newspaper in Burlington, Vermont, and his subsequent contributions to insurance discussion over the signature of "Secretary," and otherwise, showed a combination of the *littérateur* and the practical insurance man rarely equalled. A few years before his death he retired from the insurance business, and, removing to New Jersey, was elected a member of the State legislature.

——The Delaware Mutual Safety Insurance Company of Philadelphia presents its annual statement. It is a trustworthy exhibit of an honorable office. As the Boston fire of November, 1872, occurred after the annual statement of the year, the result of the fire to the company appears this year. Immediately after the great conflagration, the company reported its losses at $375,000. Such losses, when all paid, footed up exactly $370,205.96. The fire business of the year otherwise shows a profit. Notwithstanding the severity of the marine disasters, there is a surplus of earned marine and inland premium. The assets, all undoubted securities, make a total of $1,649,909.83, after marking down the values to the panic prices ruling in the market at date of report.

——A venerable citizen of Philadelphia, Samuel W. Jones, Esq., died November 7, 1873, aged 92. For many long years he was most honorably identified with the business interests of the city. He was a director of the Insurance Company of North America at the time of his death, and had held the position from January 13, 1807. When he was first elected, Thomas Jefferson was president of the United States, and Philadelphia was a town of 90,000 people. His directorship spanned the whole historic period from Prussia prostrate at the feet of the first Napoleon, to the overthrow of France by Prussia. He knew the financial progress and financial vicissitudes of the nineteenth century as few men knew them.

——There is no section in the proposed new constitution of Pennsylvania specially referring to the taxation of foreign insurance companies. The first clause of Section 1, Article IX, is as follows:—

> All taxes shall be uniform upon the same class of subjects within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws.

The following is Section 5 of Article XVI:—

> No foreign corporation shall do any business in this State without having one or more known places of business, and an authorized agent or agents of the same, upon whom process may be served.

——With courteous expressions on both sides, Mr. Nat. B Freeman withdraws from the New York agency of the Baltimore Underwriter, stating, "its business management no longer requires my services, while Bombaugh's pen is all-sufficient under any emergency." Mr. Freeman has allied himself with The Agent and Policy-Holder. Of the out-door attachés of the insurance press, he is one of the keenest and widest awake;

> —knows all qualities with a learned spirit
> Of human dealings,

and it will not be his fault if the A. & P. does not report its cause aright.

——We receive Vols. I and II, bound, of the Herald, of Chicago. Some hard things have been said of the Herald, which it rather relishes, and so reprints them. We must say, however, that we admire its frankness, and freedom from cant and silly pretension. When at its best, it is conservative, practical, and sound. Had we any asperity towards the Herald, it would surely soften as we read in its last issue the heart-utterances of the requiem breathed to the spirit, passed and gone, of the laborious and faithful William Stadden.

—— It is thought by Mr. Elizur Wright that the absence of a stipulated surrender value from the policy is the great defect of life insurance. If we remember rightly, the first time we heard of such a stipulated surrender valuation, it was on a policy of the late Anchor Life Insurance Co.

——There seems to be a need for some determinate adjudication as to whether of the two parties to an illegal insurance contract, one, as to right of recovery, has a different legal status from another; *i e.*, while the insurer cannot recover premium for such policy, is the insured debarred from claim in event of loss? In other words, does the acceptance of an invalid issue make common guilt, or the invalidity of the *issue* affect the *contract itself* to its ultimate bearing?

——To Mr. Tillinghast, of the Boston Index, the insurance public is indebted for a pamphlet report of the proceedings of the fourth session of the National Insurance Convention. This work has been done by Mr. Tillinghast gratuitously, the convention being without funds. Secretary Oliver Pillsbury is the compiler of the report, and the brief compilation embraces the substance of the convention's doings.

——Now comes W. E. Tait, et al. *vs.* the New York Life Insurance Company, and the United States District court of the Western district of Tennessee therein sets forth, that the war of the rebellion abrogated the life policies existing between Northern insurers and the Southern insured—did not merely suspend them.

——Our correspondent "Jukes" is informed that there was an increase in the asset total of the North America Life Insurance Company of New York at end of '72 over '71. Income returns, as itemized, do not cover every source of asset growth.

——"Not more than between forty and fifty thousand dollars," the Baltimore Underwriter learns, will be the total of the losses of the Southern Life Insurance Company of Memphis, through the yellow fever epidemic at Memphis and Shreveport.

——Dollars 146, cents more or less, is the net valuation of each company's liability for refurnishing the Kentucky commissioner's office—a business about which the National board proposes to supervise the commissioner.

——Suit is to be brought against a New Haven insurance agent, for violating the Connecticut insurance law by doing business for the Hibernian Mutual Fire Insurance Company of Newark, N.J.

——Commissioner Forster has commenced proceedings to test the right of the Hope Mutual Fire Insurance Company of Philadelphia to continue business as a mutual company.

——The most significant of recent life insurance events is the accession of President Winston, of the Mutual Life, of New York, to the membership of the Chamber of Life Insurance.

——Mr. E. C. Rollins, of Philadelphia, has resigned his general agency of the Great Western Insurance Company of New Orleans.

——An insurance agent at Chenango Forks, N.Y., was arrested for burglary! The grand jury could find nothing burglarious about him.

——The receiver of the late International Fire Insurance Company of New York is settling with the company's creditors at 75 per cent.

——The affairs of the late much-protested North Missouri Insurance Company pass into the hands of a receiver—W. R. Walker.

——The stockholders of the New Orleans Mutual Insurance Association have voted to reduce their capital stock.

——New Jersey is overrun with insurance wildcats.

RAILWAYS AND TRANSPORTATION.

IT may perhaps be assuming too much to charge that the present financial embarrassments of the country had their origin in, and are the exclusive result of, the farmers' movement against railroads, but such a supposition is by no means without foundation. A very large percentage of the capital invested in Western railroads came from the Eastern States and Europe, and the capitalists of both sections have always had a healthy fear of the vagaries and crude ideas of business with which the masses are supposed to be imbued. When, therefore, the first symptoms of an organized political crusade against the carrying companies became manifest, it found capital ready to take the alarm, and the result was the almost impossibility of procuring money to settle with contractors for work already done, letting alone new contracts, or even the finishing of the old. One of our most enterprising business houses largely interested in the construction of Western railroads, and which, having under the then reasonable faith in prospective sales of bonds, had made large advances towards railway construction, found itself without a market, and was obliged to suspend with a surplus of what, under previous circumstances, was deemed ample security for the money spent. This suspension of course started a panic; nor is confidence yet restored, although the signs of the times indicate that the worst is over. The building of new railroads in the far West is for the present effectually stopped. The railroads of Illinois, which received the first onset of the grangers, have been badly damaged, and their business driven to other lines. No considerable reduction has been effected in the charges of transportation between the East and the West, and within the limits of Illinois the prices have been levelled "up" instead of down. The serious shock which railway building has received has reacted upon all other branches of business, and there were never so many mechanics and laborers out of employment since "57," and upon the whole the grangers have no great reason for congratulation. Yet, serious as the results are and will be to unfinished roads, there is reason for believing that beyond a temporary embarrassment to the older corporations, the effects of the panic will not be felt by them adversely. The exodus of skilled artizans from the older to the newer roads will not only be stopped, but the movement will probably be reversed, and, as a natural consequence, labor will become cheaper and more manageable, and it will be possible for superintendents to not only devise, but carry out a thorough system of reform in many branches of railway management, which is needed to bring the expenditures down to a proper proportion with the receipts. It will probably also assist the managers in curtailing some portion of those mysterious expenses which are popularly supposed to assist so materially in swelling legitimate expenditures; and as no great reduction in transportation charges or the volume of business is likely to occur in the future by reason of the prevailing stagnation, it will not be singular if the ultimate effects of the panic are favorable to those roads which had their business established before its advent.

——ARTICLES of association have been filed in the office of the secretary of State at Trenton, N. J., for the construction of a railroad from Prattsville to Flemington, in Hunterdon county. This road, when finished, will constitute the connecting link of the new route between Philadelphia and New York—the route being by way of the North Pennsylvania railroad to Doylestown and Prattsville; thence to Flemington, and from Flemington, by the South Branch railroad and New Jersey Central, to New York.

——The Chicago and Northwestern Railway Company, the largest combination of carrying companies in the West, has published the fourteenth annual report of its operations—this report being for the year ended May 31, 1873. The number and length of roads operated under this common name and management are as follows:—

Wisconsin division, from Chicago to Menominee, 291.60 miles, with two branches, 77.40; total mileage	369.00
Galena division, a line from Chicago to the Mississippi, opposite Clinton, and one from Chicago to Freeport, aggregating 258 miles, with three branch lines, 49.90 miles; total mileage	307.90
Jowa dlvision, from Clinton to the Missouri river, opposite Omaha, 352.90, and branches, 91 miles	443.90
Madison extension, three divisions	163.80
Peninsular division	168.72
Milwaukee "	85.00
La Crosse, Templau and Prescott railroad	29.00
Winona and St. Peter's "	292.25
Northwestern Union railway, Milwaukee to Fond du Lac	67.70
Total miles operated	1,849.57

Certain of the above roads are, however, not embraced in the stated receipts and expenditures, and other portions were not completed until late in the year, so that the average mileage for the year is estimated at 1,382.18.

The substantial completion of the three main trunk lines of the company—one connecting Chicago with the Union Pacific railroad, one connecting with St. Paul and the Northern Pacific, and a third connecting Chicago *via* Milwauke with the iron and copper region of Northern Michigan—is announced, and the increase in mileage for the year is put at a trifle over 145 miles.

The entire property of the company is represented by common stock and scrip	$14.993,020 40	
Preferred stock	21,484,063 42	
		$36,477,083 82
Currency bonds	$14,624,500 00	
Gold bonds	10,384,000 00	
		.25,008,500 00
Surplus of income account		1,629,967 84
Total		$63,115,551 66

INCREASE OF DEBT.

The company has increased its common stock during the year	$182,040 00
" " preferred " "	416,400 00
Total stock increase	$598,440 00
The total bond increase for the year was	500 00

It was determined, last November, to create a new mortgage on all the property of the company subject to existing liens, of sufficient amount to ultimately consolidate the entire bonded debt of the combination, and a new mortgage of $48,000,00, with the Union Trust Company of New York as trustee, authorizing the issue of that amount of 7 per cent. consolidated gold bonds, having 30 years to run, in registered or coupon form, at the purchaser's option, was authorized. Of this amount, however, $35,349,000 are reserved, and can only be issued at the option of the company for the purpose of exchange, for and in place of the bonded debt of the company and of the companies forming the combination, that being the total amount of such outstanding obligations; $4,534,000 of these new bonds were sold during the fiscal year, and are included in the above statement of gold bonds.

BUSINESS OF THE YEAR.

The gross earnings were $12,736,606.75, an increase over the previous year of $1,334,445.31. The operating expenses, taxes, and renewals, were $8,178,236.71, about 64 per cent., leaving balance $4,558,370.04; from which, deducting interest, rents, sinking fund, &c., $2,374,456.31, leaves net earnings $2,183,913.53. From this sum were paid a dividend of 3½ per cent. on both common and preferred stocks, and an additional dividend of 3½ per cent. on the preferred stock, for the six months ended May 31, 1873, amounting in all to $2,019,640, leaving a surplus out of the year's earnings of $164,273.53; to which, adding balance of income account, May 31, 1872, $1,465,694.31, makes a total of $1,629,967.84 to the credit of the income account at the close of the fiscal year.

——MUCH eagerness was manifested in financial circles to ascertain what was to be the result of the deliberations of the board of directors of the Pennsylvania railroad in regard to paying the usual 5 per cent. semi-annual dividend. The meeting of the directors took place at Philadelphia, November 6th, and, after the report of the finance committee had been read, it was decided to declare a semi-annual scrip dividend of 5 per cent., payable in cash March 6, 1875, or sooner, at the option of the company.

The report of the controller, for the six months ended October 31, upon which the dividend is based, shows that (estimating the income for October) the earnings of the Pennsylvania road and branches for this period were $13,202,701.82; expenses for the same period $8,071,393.69; leaving net earnings $5,131,308.22; to which, adding balance of income from interest on sundry bonds of other companies $918,294.78, makes total profits $6,049,603. The gross earnings of the United companies and canal of New Jersey for the same period were $5,625,267.77; expenses of operating, &c., $3,940,986.76; leaving net earnings $1,684,281.01; to which, adding $76,632.28, income from property of United companies, makes total profits $1,760,913.39; against which are $1,820,249.28 to be paid as rent, &c., leaving a deficit of $59,335.89—thus reducing the net profits of the combination to $5,990,267.11. Against this amount the treasurer's statement shows:—

Amount required for interest on mortgage bonds	$880,511 70
Premium on gold	71,092 75
State tax on coupons and capital stock	215,751 18
Due on purchase of State works (semi-annual)	230,000 00
Rent of Harrisburg and Lancaster railroad	65,123 29
Interest on real estate, bonds, and mortgages	23,351 75
Dividend of 5 per cent. upon capital stock	3,363,419 37
Total	$4,849,250 04
Leaving balance to credit of income account	$1,141,017 07

Under the circumstances the payment of the dividend in scrip must be regarded as a result of currency stringency, as there is evidently plenty of means to have otherwise paid in cash. The scrip dividend bears interest at the rate of 6 per cent., and is receivable at par for the unpaid instalments of the new stock—the time for which payment having been extended from October 31 to December 31.

Col. T. A. Scott, first vice-president, from a sense of delicacy under his personal pecuniary complications, offered his resignation, which was very promptly and properly declined by the board.

——THE Texas and California Railway Construction Company, a corporation organized for the purpose of building the Texas Pacific railway, has been obliged to suspend operations. The liabilities of the company are in round numbers $7,000,000. Against this sum the company shows 300 miles of completed railway in operation; about 150 miles more graded and bridged and ready for the iron, worth more than the company's liabilities in ordinary times. There are in addition about $2,000,000 unpaid construction stock, most of which will, it is said, be promptly paid; and 10,000 acres of land per mile of road granted by the State of Texas, worth a large sum now, and probably in the near future more than the company's liabilities. Under the circumstances there ought to be no difficulty in making satisfactory arrangements with the creditors. This suspension created an uneasy feeling at first, owing to the fact that prominent officials of the Pennsylvania railroad were largely interested in the construction company; and the report that the latter company was involved in the failure gained credence for a short time, but has been completely dissipated by the showing that the Pennsylvania road was not in any manner interested.

——THE following is the text of the article upon railways and carrying corporations in the new constitution of Pennsylvania, soon to be submitted for acceptance by the people. The reader can examine in how far the article subverts private capital to public uses, and in how far it tends to separate "transportation" from railroading—*i.e.*, the furnishing of the track and motive power.

SECTION 1. All railroads and canals shall be public highways, and all railroad and canal companies shall be common carriers. Any association or corporation organized for the purpose, shall have the right to construct and operate a railroad between any points within this State, and to connect at the State line with railroads of other States. Every railroad company shall have the right with its road to intersect, connect with, or cross any other railroad, and shall receive and transport each the other's passengers, tonnage, and cars, loaded or empty, without delay or discrimination.

SEC. 2. Every railroad and canal corporation organized in this State shall maintain an office therein, where transfers of its stock shall be made, and where its books shall be kept for inspection by any stockholder or creditor of such corporation, in which shall be recorded the amount of capital stock subscribed or paid in, and by whom, the names of the owners of its stock, and the amounts owned by them, respectively, the transfers of said stock, and the names and places of residence of its officers.

SEC. 3. All individuals, associations, and corporations shall have equal rights to have persons and property transported over railroads and canals, and no undue or unreasonable discrimination shall be made in charges for or in facilities for transportation of freight or passengers within the State, or coming from or going to any other State. Persons and property transported over any railroad shall be delivered at any station at charges not exceeding the charges for transportation of persons and property of the same class in the same direction to any more distant station; but excursion and commutation tickets may be issued at special rates.

SEC. 4. No railroad, canal, or other corporation, nor the lessees, purchasers, or managers of any railroad or canal corporation, shall consolidate the stock, property, or franchises of such corporation with, or lease or purchase the works or franchises of, or in any way control any other railroad or canal corporation owning or having under its control a parallel or competing line; nor shall any officer of such railroad or canal corporation act as an officer of any other railroad or canal corporation owning or having the control of a parallel or competing line, and the question whether railroads or canals are parallel or competing lines shall, when demanded by the party complainant, be decided by a jury as in other civil issues.

SEC. 5. No incorporated company doing the business of a common carrier shall, directly or indirectly, prosecute or engage in mining or manufacturing articles for transportation over its works; nor shall such company, directly or indirectly, engage in any other business than that of common carriers, or hold or acquire lands, freehold or leasehold, directly or indirectly, except such as shall be necessary for carrying on its business; but any mining or manufacturing company may carry the products of its mines and manufactories on its railroad or canal not exceeding fifty miles in length.

SEC. 6. No president, director, officer, agent, or employé of any railroad or canal company shall be interested, directly or indirectly, in the furnishing of material or supplies to such company, or in the business of transportation as a common carrier of freight or passengers over the works owned, leased, controlled, or worked by such company.

SEC. 7. No discrimination in charges or facilities for transportation shall be made between transportation companies and individuals, or in favor of either, by abatement, drawback, or otherwise; and no railroad or canal company, nor any lessee, manager, or employé thereof, shall make any preferences in furnishing cars or motive power.

SEC. 8. No railroad, railway, or other transportation company shall grant free passes, or passes at a discount, to any person except officers or employés of the company.

SEC. 9. No street passenger railway shall be constructed within the limits of any city, borough, or township without the consent of its local authorities.

SEC. 10. No railroad, canal, or other transportation company, in existence at the time of the adoption of this article, shall have the benefit of any future legislation by general or special laws, except on condition of complete acceptance of all the provisions of this article.

SEC. 11. The existing powers and duties of the auditor-general in regard to railroads, canals, and other transportation companies, except as to their accounts, are hereby transferred to the secretary of internal affairs, who shall have a general supervision over them, subject to such regulations and alterations as shall be provided by law; and, in addition to the annual reports now required to be made, said secretary may require special reports at any time upon any subject relating to the business of said companies from any officer or officers thereof.

SEC. 12. The general assembly shall enforce by appropriate legislation the provisions of this article.

——ST. LOUIS is setting an example to other places in solving the problem of traversing cities by steam cars, and thus reducing the cost of transhipment to a minimum. The plan proposed is for the city to purchase and grade a tract of land 300 feet wide, and extending from the heart of the city to beyond the city limits. This avenue is to be sunk below the level of the streets, and is to terminate in a grand union depot, from which twenty tracks will be laid along the sunken way, and all railways have an equal privilege of using them. The depot is to be connected with the levee by a tunnel now in progress of construction. This plan is so much at variance with the old fogy notions which continually make their appearance whenever a railway company desires the privilege of traversing a town, that it cannot be too highly commended. No city can logically afford to refuse railways any reasonable privilege, from the fact that these corporations, from their business ramifications and connections, represent the prosperity of the nation, and any injury to their business must seriously react upon the community.

The concentration of trade and the transhipment of freight are the most powerful if not the only agencies by which great cities are built, and railways are the great modern means by which these are carried on; yet one would think, by the outcry that is raised, does a railway company solicit the privilege of traversing some obscure street to connect with river or ocean, that nothing but the total destruction of the place is to be expected. Again, there is a sort of superstition connected with the advent of a locomotive upon the street that is certainly ridiculous. We do not advocate the promiscuous running of locomotives upon every street, nor upon any considerable number, but every city can spare at least one sunken thoroughfare to be bridged where other streets cross. There is something inexpressibly disgusting in witnessing the trade of a city hampered and jeopardized by a blind adherence to old notions, and a fear that some individual may possibly get injured should modern ideas be adopted, and one almost wishes that the authors of these prejudices could have gone peaceably to sleep with the Conestoga wagons whose disappearance they mourn.

——ANOTHER trial of the application of steam as a propelling power on canals, for the purpose of gaining the $100,000 prize offered by the State of New York, took place at Syracuse in October. The nearest approach to gaining the prize was by the Baxter, a boat carrying 200 tons of cargo, drawing 5 feet 8½ inches of water, and propelled by two Baxter engines of 25 horse-power, weighing 5 tons, which drive two three-bladed propellers of 4½ feet diameter and 4 feet pitch. This boat travelled from Syracuse to Utica in a trifle over 18 hours, at an average of about 3 miles per hour, and consumed only 830 pounds of hard coal. This was by far the most economical consumption of fuel—the competing boats burning largely in excess of this amount—one of them reaching upwards of 7,000 pounds. None of the performances, however, were deemed satisfactory by the commissioners and the prize was withheld, but they were hardly justified in the statement that "with the present size of canals the economical propulsion of boats by steam power was an impossibility." Much has been already accomplished in this direction, and the mechanical genius of the age is surely sufficient to elucidate the problem.

——THE recent election of directors of the St. Joseph and Denver City railroad, which took place at St. Joseph, Mo., has created a strong feeling of opposition on the part of the minority, they denying the validity of the election. It seems that about $4,000,000 of stock were represented at the election. Of this amount the city of St. Joseph holds $500,000, parties in Kansas $1,114,000, and the remainder is held by parties in New York. At the election the stock owned by the city and Kansas parties was voted for a certain board, but was overborne by the stock owned in New York. Upon the result of the election being ascertained the mayor of St. Joseph entered a formal protest against it, upon the ground that the stock owned in New York had never been paid for and was illegally issued. Measures are being taken to test the validity of the election in the courts.

——COMMANDER SELFRIDGE, U. S. N., who has been superintending the survey of various routes for a ship canal across the isthmus of Darien, has formed and promulgated an opinion on the subject, which has had the effect of again awakening the interest of boards of trade in the proposed transit. The route favored by him is from Chiri-Chiri bay, on the Pacific coast, to the Atrato river, which empties into the Gulf of Darien. The distance from Chiri-Chiri bay to the proposed point of intersection with the river is about 28 miles, and at this point, 140 miles from its mouth, the river is 900 feet wide, 40 feet deep, and 46 feet above mean tide, and is said to be navigable for the largest vessels from thence to the ocean. The estimated cost of the work is $60,000,000, and the estimated net annual receipts from tolls $5,000,000.

PATENTS, ARTS, AND SCIENCE.

[This Department is under the editorial charge of **William H. Wahl, Ph. D.**]

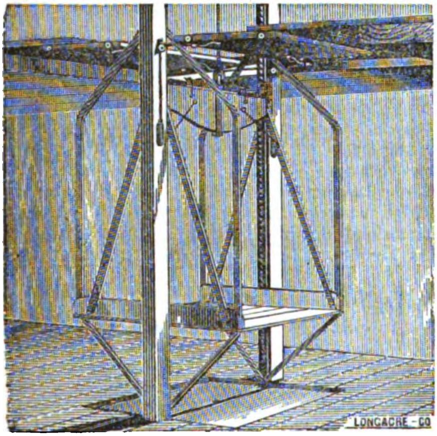
AMERICAN irons have now reached figures about 40 per cent. below the November prices of last year. These rates have brought some large buyers into the market, and there are sales at the last quotations given below. There is a little doing in Scotch pig—sales slightly below cost of importation; prices abroad are still weakening. Total shipments during October 51,459 tons, against 50,397 tons same month last year. Direct shipments to Philadelphia, 1,412 tons. We hear of one or two negotiations in progress for railway iron.——There is a report in New York that the agents of the Black Ball line have received overtures from a Liverpool firm to carry, in their ships, 50 tons of American bar iron per month, for twelve months, to that port. The negotiations, it is said, have not yet been consummated, because of the high rate of freight demanded; but it is intimated that at a freight of 10*s.* to 15*s.* the arrangement for shipping this American iron to Liverpool would be carried out.

November Iron Report.

	1st.	8th.	15th.	22d.
AMERICAN FOUNDRY PIG:—				
Lehigh, No. 1	$33.00	$32.00	$32.00	$32.00
" No. 2	31.00	30.00	30.00	30.00
" " (plain)	28.00	27.00	27.00	27.00
" No. 3 (gray forge)	27.00	26.00	26.00	26.00
" No. 4 (mottled)	26.00	25.00	25.00	25.00
" White	22.00	20.00	20.00	20.00
Schuylkill, No. 1	33.00	32.00	32.00	32.00
" No. 2	30.00	29.00	29.00	29.00
" Gray forge	25.00	25.00	26.00	26.00
" Mottled	25.00	25.00	25.00	25.00
" White	20.00	20.00	20.00	20.00
SCOTCH PIG:—				
Gartsherrie	45.56	45.92	44.61	44.10
Coltness	45.56	45.92	45.12	44.73
Summerlee	43.90	44.26	43.84	42.98
Langloan	44.28	44.64	43.84	43.47
Calder	44.28	44.64	43.84	42.99
Carnbroe	43.65	44.00	43.33	42.98
Glengarnock	43.65	43.74	43.07	42.98
Eglinton	43.65	43.74	42.82	42.85
Dalmellington	43.65	43.74	42.82	42.85
Old rails, D.H.'s	42.50	42.50	42.50	42.00
" T's	41.50	41.50	41.00	41.00
English rails (ex. ship.)	65.00	65.00	65.00	65.00
American rails (manufact'd in Penna.)	70.00	70.00	69.00	69.00
No. 1 Wrought scrap	37.00	37.00	35.00	35.00
Cast scrap (machinery)	27.00	27.00	25.00	25.00
Stove-plate scrap	23.00	23.00	20.00	20.00
Wrought turnings	30.00	28.00	25.00	23.00
Cast "	22.00	20.00	20.00	18.00
American refined bar	$3\frac{2}{10}$c.	$3\frac{2}{10}$c.	$3\frac{2}{10}$c.	$3\frac{2}{10}$c.
" common bar	65.00	65.00	63.00	62.00
Railroad spikes	.04	.04	.03¼	.03½
Nails (⅌ keg)	4.75	4.75	4.50	4.50
Street rails (deliv'd on car, Broad & Willow)	70.00	70.00	70.00	70.00

——It seems that many merchants and manufacturers are not fully alive to the value of employing the balanced hand or steam elevators for labor saving, time gaining, and convenience. As an incidental item, we may remark, the use of elevators increases the value of upper stories of buildings by placing them within easy and economical communication with the delivery or receiving floor. We give an illustrated description of a system of hoisting machinery, for some years in very successful operation, and known as the Howard Safety Elevator and Hoisting Machine. A well-tested invention in this direction, though it may have lost the name of novelty by years of use, is nevertheless a subject of interest at all times; in view of which fact, we call attention to the essential features and the method of operating the machinery in question.

Fig. 1.



The steam elevators are so arranged as to be used either with an independent engine, or connected with line shafting, in any story, near to or distant from the hatchway. The machines are built in the best manner, of durable materials fitted to gauges; constructed upon one base, so as to be fastened to a foundation, or suspended by the use of four bolts having self-oiling, independent bearings, for loose pulleys. The belt-shifters employed possess certain advantages, and are the patent of Mr. George C. Howard. The brake is brought into action when the belt is shifted. An adjustable screw and clutch stop motion controls the movement of the machines at any point, thus affording an effectual preventive against accidents. The shifting attachment moves easily. For passenger elevators, the machinery and carriage move smoothly and noiselessly; the usual safety appliances of double ropes, balanced safety catches are used. In several localities, where these elevators for freight had been introduced, they have, since their erection, been employed exclusively for passengers.

Fig. 1 illustrates a regular cage, with guide-posts at the sides of hatchway, with safety attachments and opening irons for automatic doors for hatchway, which are opened and closed as the cage passes up or down, keeping the hatches closed all the time. This improved arrangement, while it permits the free passage up and down of the platform, prevents communication of fire by certainly shutting off the draft from different stories, and effectually prevents accidents from falling down hatchways. The device may be used either for power or hand elevators, and may be attached to any cage already in use. It has two sides open for receiving and discharging load.—Folding-doors are also constructed for locations where the rolling-door cannot be applied.

Fig. 2.

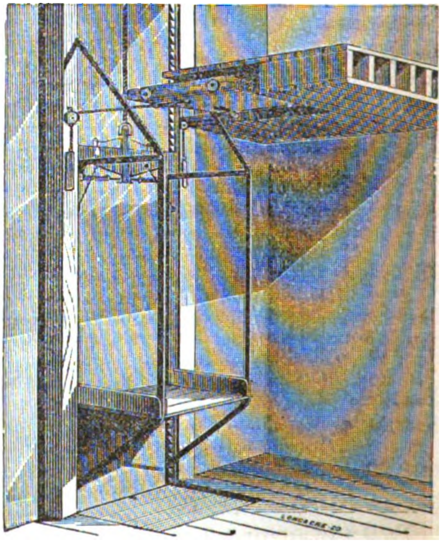
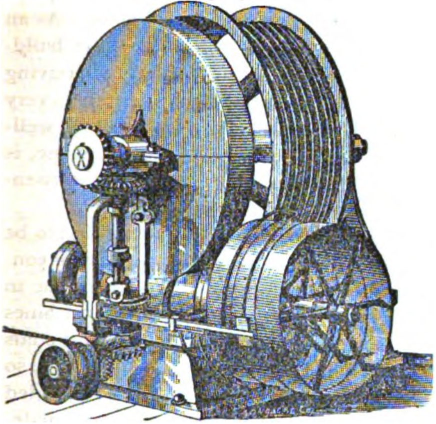


Figure 2 represents a projecting cage, with guide posts at the back, against the wall; spring safety attachment, and the self-opening and closing doors for hatchways. It might be mentioned that these automatic doors can be arranged to

Fig. 3.



work with any style of elevator. The hoisting machines are compact, occupying very little space. The loose pulleys run on self-oiling, independent bearings, furnished with adjustable clutches, operating automatically at limits of hoist—thus preventing the rope from unwinding from drum and giving rise to damaging accidents. Fig. 3 shows power hoisting machine set on cast-iron base, ready to connect with steam engine or line shafting. The platforms are furnished with automatic safety attachments, operated with elliptic and spiral springs working in connection with the racks fastened to the vertical post, on sides or corners of hatchway; and the method of balancing the platform and operating the safety attachments by means of bell-cranks and weight, in connection with the racks, is an important improvement over the practice heretofore in vogue.

——THE following information concerning the proceedings of the United States commission, created for the purpose of determining, by experimental tests, the causes of steam-boiler explosions, has been made public. The experiments are to be conducted, in part, at Sandy Hook, and in part at Pittsburgh. They were originally expected to occur in September, or during the early part of October. The preparations for their undertaking, however, and the time consumed, proved to be so much greater than was at first anticipated, that it was found impossible to begin the tests before Friday, November 7th, when the officers of the commission and a number of invited experts proceeded to Sandy Hook to inaugurate the direct labor for which they had made such extensive arrangements.

Two marine boilers had there been properly erected for the experiments; one of them, a small upright tubular boiler, and the other a large low-pressure boiler, such as is in general use on the steamers plying the rivers of New York. The first trial was with the small boiler, with which some trouble was met, owing to a leakage in the feed-pump. The spectators occupied a safe position behind a bombproof casemate, about 200 yards away. Finally, after several hours of impatient waiting, a violent noise and the bursting forth of a thick cloud of steam announced to the spectators that something had occurred. It was found, on inspection, that a tube had collapsed at a steam pressure of 54 pounds. The object which it was designed to attain with this experiment was to test the correctness of the theory that the tensile strength of the boiler-plates becomes materially weakened should they be overheated by low water in the boiler. The pyrometer attached below the boiler indicated that the steam in the upper part of the boiler was superheated to 750° F. when the tube collapsed. It was the generally expressed opinion, that the result of the experiment proved the correctness of the theory.

The experiment with the low-pressure boiler was of much interest. With a steam pressure of 70 pounds, a seam was ruptured on the upper part of the shell, with no further damage than to permit the discharge of steam. The rent occurred in a patch, and was about 18 inches in length. The gauges indicated the fact (which is worthy of special note), that even after the rent had occurred, the steam pressure continued to increase, and the rupture did not enlarge or extend. The obvious conclusion to be drawn from this, is that which was conclusively shown in the experiments conducted several years before at the same place, under the management of Col. Stevens—namely, that over-pressure in a boiler much weaker in some one spot than in others, will simply cause a rupture—which will act the part of a safety-valve in checking the accumulation of more steam pressure—while, with a boiler of uniform strength in all parts, the result of over-pressure would be a violent explosion, attended with possible destructive consequences.

The tested boilers will be patched up, and the experiments upon them continued. It is also designed shortly to test the numerous safety-valves which have been submitted to the commission by their makers and patentees.

——THE growth of the iron industries of Pennsylvania within the past year or two has been the subject of comment and congratulation on the part of everyone interested in the industrial prosperity of the country. The direct influence of such growth, when legitimate, bears the most beneficent results, both in adding to the material wealth and means of occupation of its citizens, and indirectly in freeing the people from dependence upon foreign producers for their supplies of such indispensable materials.

The foregoing comments were prompted by the information, just at hand, of the erection at Minersville, Schuylkill county, Pa., under the auspices of the Minersville Coal and Iron Company, of what is designated and described as being one of the most complete and best constructed blast furnaces in the State. The structure is now finished and in operation. The works cover about 16½ acres of ground, near the Minehill railroad. They were commenced November 14, 1872, and went into blast in August last, and have since been in continuous and successful operation. The following is a brief description of the buildings, furnace, and accessories:—

The cast-house is a building 50 by 100 feet, very substantially built, about one-third of which is occupied by the stack and bosh. The stack is 55 feet high, and is of heavy plate iron, supported by 6 massive cast-iron pillars, and the diameter of the bosh is 15 feet. Back of the stack is a patent air-hoist, for hoisting the ore, limestone, and coal to the tunnel-head. The stock-house is 45 by 208 feet, into which the stock is run on cars, and conveniently dumped. The hot-blast ovens, boiler and engine houses, are located on the eastern side of the cast-house. The ovens are double, and so constructed that one-half the pipes may be used while the other half are undergoing repairs, thus avoiding the inconvenience which would otherwise be occasioned, should accident happen to them. The dimensions of the hot-blast ovens are 22 by 24 feet on the ground, and 25 feet high. The boiler-house is located just back of the ovens, and contains 8 boilers, each 55 feet in length, and of 30 and 40 inches diameter. The engine-house is to the east, and contains an upright, direct-acting, high-pressure engine, of the following dimensions:—Steam cylinder, 42 inches diameter and 7-foot stroke; blowing cylinder, 7-foot diameter and 7-foot stroke. The supply of material has been arranged for bv the purchase of large ore-beds in Cumberland county, furnishing a good supply of pipe ore, and by the leasing of two valuable tracts of hematite-ore land in Lebanon county, and of two large magnetic-ore tracts in New Jersey. The supply of limestone has been looked after with equal care. All the paraphernalia of a successful furnace are here systematically arranged and provided for, and much of the success and completeness of the works has been ascribed to the energy and labors of the superintendent, Richard C. Kear, Esq.

The officers of the company are: President, Jacob S. Lawrence; vice-president, William G. Kear; secretary, Frank Heisler; treasurer, William Kear. Mr. George D. Althouse has been appointed the agent of this company, for the sale of the iron in the Philadelphia market. Mr. Althouse is an experienced iron man. Mr. J. V. Umberger is also connected with this agency.

——THE works of the Northampton Iron Company, of which some of the leading capitalists and business men of the Lehigh valley are directly interested, are situated on the south side of the Lehigh, between the Lehigh Valley railroad and the river, a short distance above Freemansburg station. The property upon which the furnace is erected is about 80 acres, and the company's ore lands have about the same extent.

The furnace dimensions are as follows: Stack, 65 feet high; diameter of boshes, 16 feet; hearth, 7½ feet; tunnel head, 8 feet. The engine is of the condensing type; diameter of steam cylinder, 52 inches; of blowing cylinder, 84 inches; stroke, 7½ feet. Much of the ore used is from the company's own ore land, while magnetic ore is brought from New Jersey. A fine quality of limestone is found on the lands near the furnace. The producing capacity is about 200 tons of iron per week. The officers are: John Knecht, president; E. P. Wilbur, secretary and treasurer. Capital stock, $250,000.

——NEAR the Falls of Schuylkill, Philadelphia, are situated the woolen mills of Messrs. John and James Dobson, the largest individual enterprise of its kind in the country. There are six main buildings, in connection with which are the numerous outbuildings common to every well-regulated mill. The buildings, taken together, cover an area of 7 acres.

The carpet department is the most interesting in its appointments and most important. This department operates 22 sets of woolen cards, 48 and 60 inches, and 2,364 mule spindles and 5,488 worsted spindles. There are also in operation 21 hand looms and 132 power looms, 80 of the latter are for two and three-ply ingrain, and the remainder for weaving Wilton, Brussels, velvet, tapestry, Venetian, and Dutch carpets.

The cloth and blanket mills run 28 sets of cards, 48 and 60 inches. Some of the blanket looms here operated are over 200 inches wide in a reed, and are probably the widest looms in the country that are operated with a driven shuttle. In these looms "two-wide" blankets are woven at one time.

This now vast establishment was originated in 1855 by Mr. John Dobson, who in that year established the business in a small building, from which nucleus, by dint of earnest application, seconded by business ability rarely surpassed, has grown the present extensive works.

A few statistics, from a mass of facts before us, will serve to show the present productive capacity. The amount of wool consumed in the last twelve months was 6,000,000 pounds; cotton warps, 450,000 pounds; the number of operatives employed is about 600 in the carpet, 500 in the blanket, 100 in the cloth mills—making a total of about 1,200; while the pay-roll of the establishment foots up to an average of nearly $50,000 per month.

The productions of the mills consist of blankets of all sizes, qualities, and descriptions; lap robes, rugs, yarns, &c.; all-wool and cotton-warp chinchillas, elysian, raye coatings, &c. The production of Axminster, velvet, body Brussels, tapestry Brussels, three and two-ply, extra superfine, superfine, extra fine, fine, and medium carpets, and all-wool Dutch carpets, constitutes a special branch of the works. The present daily production of the carpet department is about 2,500 yards; but when all the looms are fairly in operation this will not fall short of 3,000 yards.

The establishment also produces blue, green, and scarlet cloths, in all-wool and cotton warps, with and without saved selvages, a feature as yet confined to these works. The interior arrangement of the establishment is very perfect, the system of division of labor under intelligent direction and supervision being carried out to its limit. To those who can appreciate what is meant by the smooth and harmonious running of works so extensive, the necessity of such a system will be apparent. There are many new appliances in operation which are confined to this establishment, some of which are the inventions of the proprietors. Of these novelties we are only at liberty to mention one, which bids fair to become eminently successful—it is a loom for weaving pile fabrics on stationary wires, the invention of Mr. John Shinn, and owned in part by the proprietors of the works, where it is now being experimented upon. The experimental loom, upon the plan here referred to, is constructed rather lightly for weaving heavy goods, yet upon it have been woven carpets 26½ inches wide, and weighing nearly 3½ pounds to the yard.

We may observe that, to protect the establishment against destruction from fire, six men are employed at night as watchmen, and on the premises are also one steam fire-engine, one hose-carriage, and five stationary steam fire-pumps, which are connected to pipes in all the rooms, where hose is kept constantly attached.

A brief account of the differences between the several varieties of carpets, and of the peculiarities of their manufacture, may be of interest. Ingrain carpets are fabricated in all colors, and of innumerable designs or patterns, which are invariably produced with the aid of the Jacquard loom. They are woven two and three-ply, and have what may be called a right and wrong side, the colors being reversed on the two sides. With a carpet of this kind, having a figure in scarlet and black, for example, the figure will show in scarlet on one side and in black on the other. The warp yarn is mostly made of worsted, the thread being spun hard and fine, that it may appear or show as little as possible when interwoven with a filling of a different color. This is essential, since in the ingrain carpets the design or figure is formed by the filling, which for this reason is spun soft; in addition to which, each shot is mostly double and untwisted that the two threads may lie as nearly parallel to each other as possible. Such carpets are made of all grades and qualities, which gradations are dependent upon the number of threads in the warp and the number of shots of filling to the inch.

Venetian carpets are made both plain and figured; the use to which they are put being mostly for stairways and hall coverings. The plain sorts are woven on a loom of very simple construction, having only heddles and reed. The warp is a woolen yarn of heavy body, and should cover the filling so completely that it cannot be seen. The filling is any common yarn, such as jute, &c. The pattern is generally arranged in strips and shaded like the rainbow, the object of the maker being mainly to run the shades of color into one another as imperceptibly as possible. The figured Venetian carpetings are woven with the aid of the Jacquard machine, and find their way into the market under the name of Damask-Venetian.

In weaving Damask an alternating thick and fine shot of filling is employed, which is covered by the warp—the last therefore forming the figure. Some Damasks, however, are woven with two shots of thick filling and one of fine.

The carpets known as Brussels, Wilton, imperial Brussels, and royal Wilton, are all woven in looms of the same or similar construction. The worsted yarn is dyed in the hanks, and is spooled on small bobbins, with a weight attached to each to insure to the same a uniform degree of tension. These small bobbins are set in frames, and according to the number of the latter are known as three, four, five, and six-frame body Brussels.

The difference in the fabric of the styles of carpeting above named is as follows: In the Brussels the worsted yarn is raised to form the pile and show the figure, and is not cut. In the Wilton the pile is bound wfth an extra shot of filling and is cut, which gives it the appearance of velvet. In the imperial Brussels the figure is raised above the ground—that pile is cut, and the ground pile is left uncut; while the royal Wilton differs from the Wilton in having the pile raised higher than in the latter, making it a more massive carpet. The cloth of these carpets is composed of worsted, linen, and cotton. The linen is used for the filling, and the cotton as the binding warp to bind the worsted yarn, and should not appear on the right side. The better it is covered, the more perfect the carpet.

Tapestry carpet, or what is known as tapestry Brussels, is woven in looms similar to those for weaving body Brussels, with the exception that the Jacquard machine is not used to produce the figure. This is printed on the worsted yarn that forms the pile. This yarn is set or arranged in a frame to form the figure, and is then wound on the warp beam, which is let off in the loom by a positive motion, and the figure is formed by the looping of the printed yarn over the pile wires. To make tapestry velvet the pile is cut, and the carpet is generally woven with one extra shot of filling —that is, each loop is bound with two shots of filling—while in the uncut, but one shot is used to bind each loop.

The motive power is furnished by 6 steam-engines, supplied with steam from 36 steam boilers, and 1 water-wheel of 36 feet diameter and 6 feet face.

The largest building—the carpet department—has but recently been built and placed in operation. The motive power of this mill is furnished by a compound-beam engine of 600 horse-power, having some novel features. The high-pressure cylinder is 26 inches in diameter; the low-pressure cylinder, 50 inches in diameter; both have 4 feet stroke, and make 50 revolutions per minute. The cylinder, beam column, and shaft-bearing of each, rest upon deep box bed-plates. The rock-shaft bearings are cast to one end of each bed, and the crank-wheel pit formed in the other. The engines are alike in every particular except the cylinders, and are connected to one shaft, upon which are secured two 16-foot diameter fly-wheel pulleys, 37-inch faces, and each at present carrying a 30-inch wide double leather belt. These belts run over 8-foot pulleys on the line-shaft, which is extended into the engine-room from the factory.

The high-pressure cylinder is provided with two plain D slide-valves, the low-pressure cylinder with one, and all of them are disburdened of steam-pressure by packed rings—one on the back of each. An ordinary centrifugal ball governor regulates the speed. The high-pressure exhausts directly into the steam-chest of the low-pressure cylinder through a straight connecting pipe, and the cranks and valves of both engines are so set that the low-pressure begins to receive the exhaust steam from the high-pressure cylinder at the moment of its release. In each engine a slipper-guide, embraced by the cross-head, is bolted to the beam column, but has no connection with the cylinders—an arrangement which allows the cylinders to expand and contract without displacing the line of the guides, and possesses all the requisites of strength and stability, while at the same time it permits of a similar disposition of guide and cross-head to each engine, which would be difficult to produce over cylinders of such different diameters. Each engine has two beams with all the bearings between them, the centre pin resting in two boxes, which are secured in a cylindrical block adapted to a corresponding cavity in the top of the beam columns, and which may be turned about the axis of the column and secured in any position thereto by adjusting screws. Each box can be raised vertically as may be made necessary by wear from time to time. Any desired plane of vibration for the beam can thus be obtained by simple means of adjustment. The cylinders are cased with walnut staves, held in place by polished nickel bands. A very large feed-water heater—so contrived as to serve the double purpose of heating the feed and partially condensing the steam—forms part of the exhaust pipe between the low-pressure cylinder and the condenser. This plan was deemed necessary, because the water used for injection is contaminated with the waste liquors from several dye-houses, and is not fit to be used again for feed. The steam for this engine is supplied by 12 plain cylindrical boilers, 36 inches in diameter, by 36 feet long, in nests of three each. It is now working with great satisfaction, giving out about 300 horse-power, with enough in reserve, in case of necessity, to furnish power for a mill of twice the size of this one.

We have been obliged to curtail many descriptions of interesting details connected with the operations of these works, and to omit others altogether, but we trust that which has been presented will serve to afford a very general notion of these extensive mills, and of the intelligent business skill and enterprise of their proprietors.

——CONSIDERABLE attention has been given in this country of late to the subject of continuous brakes, and several more or less efficient methods of applying power brakes to practice have been perfected, and are now in constant use on some of our important railroads. Without entering into any discussion as to the merits of the compressed air and the vacuum systems, which are the best known types of the power-brake, we would simply state that the brake which is composed of the fewest parts and contains the least amount of complication will eventually outrank all others, provided it be not wanting in efficiency; for it is a question of the most vital consequence to railroad companies that the machinery employed by them shall be of the most durable description, and not subject to fits of becoming inoperative, and that it shall not be of such an intricate or complicated construction as to be beyond the comprehension or the mechanical control of the average engineer. Another statement we will venture to advance—that brake which in emergency will stop a train within one yard less distance than another must take precedence, for that one yard may save the lives of many from destruction.

With this brief introduction we will now call the attention of our readers to Henderson's patent hydraulic railroad brake. As the name implies, the Henderson brake is characterized by the use of hydraulic pressure as the retarding force brought to bear upon each and every pair of wheels carrying a train of cars. The motive power is derived directly from the steam boiler of the locomotive, and is under the immediate control of the engineer. It will thus be seen that the boiler itself becomes the reservoir of accumulated pressure, and that the same power can be employed directly to the purpose of operating the brakes as would be the case were it used through the medium of auxiliary machinery. In the invention we are considering, all that complication of machinery is dispensed with, and in its place is substituted a simple two-way cock. Three branches connect respectively with the steam boiler, brake cylinders, and tender tanks. The plug of the cock is actuated by a stem carried up through the foot plate, and furnished with a lever handle at top, convenient to the hand of the engineer. The normal position of this cock when the train is running, is such as to maintain a communication between the tank and the pipe leading to the brake cylinders (one cock being open, and two closed). When the engineer desires to apply the brakes he simply turns the plug of the two way cock so as to shut off the tank, and opens a communication from the boiler. The full force of the steam pressure is brought to bear upon the water column, and a hydrostatic pressure of equal intensity is distributed to the area of every pressure cylinder under the cars. The last receives the same force as the first, and the result upon the whole is practically instantaneous. Hydraulic pressure, transmitted through long distances, and effectively operating cranes, and other machinery, is now so common, (as witness the Bessemer plant,) that it is needless to enlarge upon a matter so definitely settled, as far as its practicability for the present purpose is concerned. The objection to be apprehended from fluid friction in the pipes is so small as to pass without comment; and there is no reason why there should be any diminution in the pressure from the steam boiler any more than there is to be found in placing steam pressure gauges in the offices of manufactories far removed from the boilers, as is now so common. One end of the bar of water being touched, the result is instantly telegraphed, as it were, to its extremity; in fact, a French mechanician, M. Tommasi, has employed hydraulic pressure with marked success as a medium for transmitting telegraphic signals, using a small copper tube—the impress being instantaneously transmitted.

Passing to the second feature of the invention, we find that instead of using under the cars, cylinders fitted with pistons, which again have to be kept well packed and lubricated, and connected by levers and long rods extending from one end of the cars to the other, with recoil springs to bring them back to their normal condition when the pressure is relieved, Mr. Henderson has made another innovation by dispensing with the whole paraphernalia, and substituting therefor an exceedingly ingenious and simple device. Between the wheels of each truck carrying the car there is placed a cylindrical vessel of cast-iron, whose ends are formed of two dish-shaped flexible diaphragms of India-rubber, secured to the drum, and making an air-tight joint at the periphery, by bolting thereto concentric rings; two rams, working in opposite directions, are fitted to the insides of the dished diaphragms. Their outer ends are attached by bolts to the cross-beams carrying the brake shoes, when the pressure comes between the diaphragm, it simply forces them apart, and puts the brakes on the wheels in the most direct manner possible. And when the pressure is relieved, the diaphragms collapse and cause a discharge of the fluid which separated them. The peculiar construction of this device, it will be seen, possesses all the requirements of a cylinder and working piston, as well as the recoil springs. All piston-packing and stuffing-boxes are dispensed with, and no lubrication is required; the interior is sealed from dust, all complication of levers and rods and attendant lost motion is done away with, and its operation is isolated from all connection with the usual hand gear, which remains as efficient as it was before. A modification of this device is also used when the brake shoes are arranged on the outside of the wheels, which is even of a simpler character. One of the diaphragms and rams is dispensed with, and the casting is bolted to the outside of one of the brake beams. Action and reaction being equal, when pressure is applied the casting presses one way and puts its brakes directly on, and the ram going outwards draws the opposite brakes on by means of two rods attached to the head of the ram, proceeding over and laying hold of the other brake beam.

We now come to the third and last part of this invention, rendered necessary by the fact that in low temperatures, water employed to operate the brake would inevitably freeze; to obviate this difficulty there is used a cylindrical vessel furnished with three suitable cocks, check-valve, and tank, to supply a non-freezing fluid for the purpose of operating the brake cylinder, such as glycerine, or a mixture of glycerine and water, solutions of the chlorides of sodium or calcium, or other substances of a similar character. A mixture of equal parts of glycerine and water is probably the best, and is safe to about 30° below zero, while glycerine itself never freezes. A flexible diaphragm is contained in this vessel which acts as a separator to prevent the fluids on either side of it from commingling. The cylinder can be bored and fitted with a weighted piston to answer the same purpose. This device will only be required in those climates where a liability to freezing of water would occur, and are only necessary under such circumstances. It can be brought into play or isolated at any time by a proper adjustment of the several cocks. One being closed, and two opened, the non-freezing fluid is employed, instead of the water from the tender tank. The cylinder is automatically charged from the small tank in case of leakage, by the fluid passing the check-valve whenever a vacuity occurs; but no fluid can return to this tank, as the closing of the check-valve will prevent it.

This brake can be seen now in practical operation in Philadelphia, and we understand that it is to be put on the cars of the West Chester railroad as soon as the work can be got out, and other roads are negotiating for its introduction. It has been patented in Europe as well as in the United States. We have endeavored, in what has preceded, to give our readers a comprehensible description of what appears to us to be an eminently useful invention, and one deserving the attention of those connected in any way with railroads.

——AT a late meeting of the Franklin Institute, Mr. Thomas S. Speakman, one of the society's representatives, in the course of his report to that body remarked, that during his stay in England he had had the opportunity of witnessing on an extensive scale the operation of a new system of burning bituminous coal and other kinds of fuel, which rendered the combustion so perfect as to prevent the giving off of smoke, thus effecting an economy in heating power amounting to 35 or 40 per cent. The speaker announced that the invention in question was of American origin, and gave the following description of the apparatus and the principles of its operation: It consists of a blast from a fan or a blower, introduced under the fire-grate into a tight-fitting ash-box, which, passing through the fire, is met at its upper surface by a back atmospheric pressure, created by one or more pipes, descending from that point of the furnace where the heat and smoke usually escape into the chimney. To create the back pressure, to which we refer, the downward pipes are employed. The air from the fan or blower meets this back pressure in the body of the fire, and produces a combustion like that from an ordinary blowpipe so perfect as to prevent the generation of smoke. All the combustible matter of the coal or other fuel being consumed, nothing escapes save the residual carbonic acid and nitrogen gases, which, if permitted to remain, would extinguish the fire. To avoid that difficulty the pressure of the fan is somewhat greater than the back atmospheric pressure, thus keeping up a slight circulation from the furnace into and through the down-pipes, as above described, by which means the heat of the waste gases, usually passed out at the chimney, may be utilized to heat water in a tank, in which these pipes, or the succession of down-pipes, are immersed, the water thus heated affording additional economy in the process.

If the operation of this apparatus, which may be applied in almost every situation where heat is employed in boilers, furnaces, &c., realizes but a portion of the advantages claimed for it, there can be little doubt of its great value, and of its rapidly winning its way into general use.

——ATTENTION has been called to a valuable, and thus far unutilized vegetable product, the Ixtle fibre, (*Bromelia Sylvestris,*) which grows abundantly on the southern shores of the gulf of Mexico, and is remarkable for its lustre, strength, and flexibility. Within the thin envelop which forms its leaf there is a perfect skein of thread of extraordinary tenacity, length, and fineness. The outer covering, or cuticle, can be easily removed by simple chemical or mechanical means, and thus the whole fibre can be made available without further expense. It is proposed to use all the refuse leaves not utilized for ropes or textile fabrics, for paper, cured and baled like hay. This Ixtle fibre, according to the account we have of it, requires but little cultivation, and the leaves can be dried for a few days in the sun. It is open to question whether a fine quality of paper for banking cannot be made from the fibre. The plant, it is said, can be brought to the chief manufacturing cities of the Union for about $50 per ton.

——A PROJECT, having for its object the union of Ireland and Scotland, by means of a submarine tunnel—which has once or twice been mooted—is now proposed again, and with some reasonable prospects of a hearing. The plan projected, designs the construction of a single line tunnel, 15 feet wide at base, 25 feet wide at the maximum, and 21 feet high—the side walls of which would vary from 4 to 7 feet in thickness. The length of this tunnel would be about 12 miles, and it would extend from a point on the north shore of Ireland, near the city of Belfast, beneath the Irish sea, to the extremity of the peninsula opposite, in Scotland. The estimated cost of this undertaking is $23,000,000.

——THE process of Leblanc for the manufacture of soda from common salt has, for nearly a century, almost, if not quite, entirely excluded all others from competition, and has supplied the world with the vast quantities of this material so indispensable in the arts, manufactures, and the household. The peculiar circumstances under which this process first originated, and the important chemical reactions which it illustrates, have, besides, lent additional interest to it, so that it has long been looked upon as a model worthy the emulation of those who seek to apply the facts of science to useful purposes.

Only six years ago, when the international jury at the great exposition at Paris were called upon to express their opinion concerning the status of the soda manufacture, they unanimously expressed the belief that the process of Leblanc would hold the field to itself for a long time to come. At the recent exposition at Vienna a similar jury, under the presidency of Prof. A. W. Hoffman, (the discoverer of the aniline colors,) gave utterance to the opinion that although the Leblanc process might hereafter be of some importance for certain branches of the industry, yet it must infallibly be largely superseded in the immediate future by another process, which, in course of time, must supplant that of Leblanc entirely.

The new process, which has attained the first importance in the eyes of the chemical world, is termed by Prof. Hoffman the ammonia process, and possesses the advantages of greater cheapness and directness over that of Leblanc. The process in question is not new in date of discovery, it having been patented in Great Britain as early as 1838; but, owing to the impossibility of obtaining ammonia at that time in large quantities and cheaply, and the comparative crudity of the branch of machine building needed for the erection of suitable apparatus, the new innovation soon sank into forgetfulness, though great anticipations were even at that early date entertained of its successful competition with the Leblanc. Now, however, that the cheap production of ammonia is a matter of no difficulty, and susceptible of an unlimited extension, and the mechanical details of construction are placed beyond difficulty, the ammonia process appears already to have developed into a flourishing industry, almost before its existence has become generally known. In England, Hungary, Switzerland, Westphalia, Thuringia, and Baden, are large soda works operated upon the new ammonia process, producing in some of them as much as 15 tons per day.

As to the chemical details of the process, it is based upon the simple and long well-known reaction of bicarbonate of ammonia upon a strong solution of common salt. (This reaction may be expressed in its simplest form as follows: $NH_4OCo_2 + NaCl = NH_4Cl + NaO,2CO_2$.) The result of this reaction is the precipitation of nearly all the sodium as a bicarbonate, and the conversion of the ammonia salt into a chloride. From this chloride the ammonia is regained by simply heating with caustic lime; while the bicarbonate of soda is simply heated to give off one equivalent of its carbonic acid, and leave the simple carbonate behind. The carbonic acid thus expelled is utilized to again convert a portion of the ammonia into bicarbonate for a second operation.

The importance of the new process cannot be over-estimated. As compared with that of Leblanc it has the great merit of effecting the *direct* conversion of the salt into carbonate. Again, the precipitation of the sodium salt does not involve that of any other metallic substances which may be present; it is again very free from impurification with sulphur compounds—all of which merits mean simply that the quality of the product is excellent. When, aside from the directness and simplicity of the chemical processes, it is added that the plant necessary for its operation is very simple, and that there are no noxious vapors produced, its importance is heightened.

It has been stated by a writer upon this subject—which is just now the topic of very general comment—that "the only weak point of the ammonia process is the loss of the chlorine, which is converted into worthless chloride of calcium." The writer in question was probably unaware of the fact that the demand for this substance is already quite large, and may even in one field of industry absorb much that is thus produced. We refer to the growing importance of the "Ransome stone," which is receiving very extended use in England in the construction of piers, sea and river walls, and general architectural purposes. For the manufacture of this stone, large quantities of chloride of calcium are required; and the abundance of this last material will, doubtless, by cheapening the manufacture of the artificial stone, exert a beneficial effect upon the latter branch of industry. Finally, the new process of soda manufacture must exert a direct and important influence upon many other branches of chemical industry.

MONETARY.

WITHOUT the late panic being fully comprehended, the feeling grows that it will best work out its own solution. The currency stringency has been mitigated, which gives present ease, but this is accompanied with a sense of its being but a temporary alleviation, liable at any time to change to the worse. In the problems of the hour, the proposition for the federal government to issue 3.65 per cent. convertible bonds gains a wide hearing, and carries some conviction as removing the theory of irredeemability from the currency under any practicable amount of issue—and if the interest were payable in gold, the "value" of the currency would be enhanced under prevailing fancies. Such an expedient would provide for an efflux or influx of the tokens of exchange, according as trade demands pressed upon or receded from the limits of the current circulation, thereby, in part, guarding against any mere currency inflation of prices; but it is objectionable as making government pay interest for funds it does not want, though it does this to protect the borrower against the lender. The scheme is more an expansion of credit than of currency.

Trouble with Pittsburgh savings banks, disclosures of New York banks saved in the critical juncture by other banks, mark the character of the floating intelligence which represses rising confidence. General trade revives slowly, but under the influence of somewhat lower prices there is increased distribution of goods. Lower rates for wages are beginning to make opportunities for the return of workmen to their work. Under the war excitement of the Virginius affair, gold advanced, and the advance was helped by the opinion that government would have to become a purchaser of gold to pay January interest.

——*Sales of Stocks, etc., at New York.*

	Oct. 27.	Nov. 3.	Nov. 10.	Nov. 17.
U. S. 6's, coupon, 1881	113	113	112¼	114¼
" 5-20's, coupon, 1862	107½	106¼	106	108¼
" 5-20's, coupon, 1864	108	107	106½	109½
" 5-20's, coupon, 1865, m & n	108¾	107	107¾	109⅞
" 5-20's, coupon, 1865, j & jy	110	109¾	110½	112½
" 5-20's, coupon, 1867	113¼	112	111¼	113⅞
" 5-20's, coupon, 1868	113	111¾	111	113¼
" 10-40's, coupon,	106⅞	106¾	104⅞	108
Pacific 6's, currency	109¼	109¾	109⅛	110
Tennessee 6's	....	....	....	80
" 6's, new	....	....	....	....
North Carolina 6's	....	....	....	....
" 6's, new	....	....	....	....
Missouri 6's	....	....	....	95
N. Y. Central and Hudson R. con	84¼	82½	80⅛	86⅝
Harlem	103	103⅛	103	108½
Erie	46	43½	38½	40½
Lake Shore and Michigan Southern	61⅜	62⅛	62⅜	66⅜
Wabash	37½	36¼	36¼	....
Cleveland and Pittsburgh	74	....	....	*77
Northwestern	34	34¼	35¼	39
" preferred	....	56½	54¾	....
Rock Island	87¾	86¾	88	87½
Fort Wayne	82	82	80	....
Milwaukee and St. Paul	....	26½	....	28¾
" " preferred	....	....	....	....
Ohio and Mississippi	23⅛	23	22⅝	23¾

* Ex. divideud.

	Oct. 27.	Nov. 3	Nov. 10.	Nov. 17
New Jersey Central	86	86	86	91
Western Union Telegraph	51	50	48⅜	57¼
Pacific Mail	30	27½	28⅝	27¾
Union Pacific	16¾	16⅜	16¼	20
Adams Express	79	79	....	80½
Wells, Fargo & Co. Express	55	56⅓	....	63
American Merchants Union Express	50	48½	....	56
United States Express	50½	48	....	57
Rate for Money	1/16	7@1/16	7	6@7

Sales of Stocks, etc., at Philadelphia.

	Oct. 27.	Nov. 3	Nov. 10.	Nov. 17
Gold	108⅛	107¾	107¾	109½
Sterling Exchange	115½	114¾	114¾	116⅞
Paris Exchange	4.92½	4.92	4.90¾	4.79½
Lehigh Valley Railroad	54½	54	54	55¾
" " 6's	....	....	93½	94
" " 7's, reg	....	....	95	96
Lehigh Navigation	23¾	22¼	23½	27⅞
" " 6's, 1884	80	80	82½	....
" " 6's, g ln	78	80	82	84
" " 6's, reg	80¼	81	82	....
City 6's, no tax	101½	100¾	101¼	102
" tax	95	96	....	96⅞
Pennsylvania Railroad	46¼	41⅝	42	44½
" " 6's, 1 m	94	97	....	97⅞
" " 6's, 2 m	....	94½	95	95⅞
Pennsylvania 6's, first series	....	....	100	....
" 6's, second series	103	104	....	104
" 6's, third series	105½	107	107	107⅞
Reading Railroad	50⅓	50⅓	50	52¾
" " 6's, mt	....	....	86	90
" " 7's, reg	98½	99	100	102⅝
Catawissa Railroad	12¼	12	12	15¼
" " preferred	37⅜	38	36	39⅝
North Pennsylvania Railroad	....	....	42	46
" " " 6's, mt	98	98	97½	....
" " " 7's, mt	99¼	99½	....	95⅞
" " " 10's, chat	....	102½	103	104
United N. J. Companies	112	114	111	113⅞
Camden and Amboy 6's, mt	....	....	91	91⅞
" " 6's, 1883	88	....	....	....
" " 6's, 1889	....	....	....	85
West Jersey Railroad 6's	....	98	....	....
" " 7's	....	....	....	....
Philadelphia and Erie	15½	15	13	17⅞
" " 6's	80	80	75	....
Allegheny County 5's, coupon	75	75	78	78
Schuylkill Navigation	5	....	5	5½
" " preferred	10	9¾	10	11⅞
" " 6's, 1882	65	68	68	70
Morris Canal	....	....	....	....
" preferred	112	....	....	....
" 6's, 1882	....	....	83	84
Little Schuylkill Railroad	....	41	41½	44
Oil Creek and Allegheny Railroad	15	14½	13	17
" " " 7's	60	60	56½	60
Philada., Germ. and Nor. Railroad	83½	82	....	82½
Minehill Railroad	49	48½	48½	50⅛
Elmira and Williamsport, preferred	....	....	....	....
" " 7's	....	93½	....	....
" " 5's	50	50	....	50
Northern Central	....	20	24	20
Rate for Money	6@8	6@8	8@	6

NOTING AND COMMENTING.

A SERIOUS complication between the United States and Spain has arisen from the late extraordinary action of the captain-general of Cuba. On the 31st of October, the Spanish gunboat Tornado captured the steamer Virginius, a vessel registered as American, and at the time of the capture flying the American colors, but which was known to have been engaged for some time in the service of the Cuban insurgents, landing supplies and reinforcements on that island. At the time of the capture, the vessel was unquestionably engaged in an attempt of this character; and there were on board a large number of persons known to be leaders of the insurgents, besides arms and munitions of war. All accounts agree that the chase of the Virginius by the Spanish war-vessel began near the coast of Cuba, and that the capture took place somewhere in the vicinity of Jamaica; but so far the precise facts as to distance from land have not transpired. There were on board the Virginius at the time of capture 165 persons, of whom 90 are said to have been natives of Cuba; gentlemen, in most instances, of wealth and culture, and the remainder were foreigners, 63 of whom formed the crew of the vessel. The captured vessel and prisoners were taken to Santiago de Cuba, where, November 2d, a court-martial was held, and the trial, for piracy, of the persons found on board commenced. From all accounts, at least 50 or 60 of the leaders captured on the Virginius have since been shot, and there seems a strong disposition to execute the entire number—ship's crew and all. This massacre has created an intense desire in the United States for vengeance upon the Cuban volunteers, by whom it was instigated, evidently against the desire of the Spanish government; but the affair is very complicated. The Virginius, from the meagre and somewhat unreliable information furnished, left Kingston, Jamaica, for Colon, Cuba, on an apparently legitimate voyage, her papers being certified correct, and most of the passengers on board, named as laborers, going to work on the railroad constructing near that place. On the other hand, the character of the vessel and the business in which she was engaged were well known, and had the authorities in Cuba contented themselves with detaining the vessel and passengers, there would have been much to justify such a proceeding; but the action of the Cuban authorities in treating the entire crew and passengers as pirates has alienated any assent which might otherwise have been given.—In Spain, no definite change in political affairs has transpired during the month. The demoralization of the Carlists and insurgents seems to have continued, although Cartagena still holds out, and movements among the Carlists are evidently not entirely of a retrograding kind.—November 5th, there was a report that a Spanish man-of-war had captured, near Manilla, two German merchantmen partially laden with arms intended for sale to the Malay pirates. This report, although not yet confirmed, created some excitement in Madrid.—October 31st, a battle was fought in the province of Navarre, near the town of Miranda del Arga, between the Carlists and republicans, resulting, seemingly, in a defeat, with severe loss, to the latter; and subsequently another battle was fought near the same place, with like result—that is, if news from Carlist sources is to be believed. At latest advices, the insurgents at Cartagena had opened a furious fire upon the government troops and ships, and their fleet was endeavoring to escape.

Whatever may be thought of the Count de Chambord as a politician, it must be confessed that he showed great frankness, as well as obstinacy, in publishing his celebrated letter, which ruined the hopes of the legitimists of placing him upon the throne of France. In this letter, which was written, or at least published, the latter part of October, and ostensibly addressed to one M. de Chesnelong, a member of the delegation of the right, who had waited upon him, the count energetically refuses to give up the white flag, indignantly repels the insinuation that he mistrusts the valor of the soldiers, ignores none of the country's glories, &c., &c., and ends by sublimely declaring that he is "the only pilot capable of weathering the storm, because he had the mission of authority." The republicans became jubilant over the publication of this letter, and the monarchists correspondingly despondent. November 2d, the Orleans princes united in a formal declaration that they would not accept the lieutenancy of the kingdom, and, as a consequence, the factions of the right moved to prolong MacMahon's power for ten years at least. The republicans, in opposition to these movements, concluded to demand an immediate election to fill all the vacancies in the assembly, and the Bonapartists declared for a *plebiscite* to determine the form of government. Some coquetting then took place between the right and left, and a compromise was partially agreed upon, by which the term of President MacMahon was to be prolonged five years. This was followed, November 5th, by a message from the president, in which he, with a frankness and modesty almost equalling the Bourbon, declared that the present assembly was the rightful government of France; that France was languishing for a more stable government, and evidently thought that no man was quite equal to the task of tranquillizing the country and Europe, except himself. November 8th, the three bureaux of the assembly which deferred naming their members to the committee on the prolongation of the powers of the president until then, elected Count de Remusat, M. Leon Say, and M. Laboulaye, all republicans—thus giving the left a majority of one on that committee. This changed the hitherto hopeful aspect of the right, and the committee organized, and after a stormy session, made a report that, although the country needed a stable government, it was inexpedient to prolong the powers of the president more than five years, and making various suggestions—among others, that there be a committee of 30 appointed to consider constitutional bills. The debate on this report promises to be exciting, as, in all probability, it is on this that the future government of France depends.—The trial of Marshal Bazaine drags its slow length along, and the end is not even visible. It has been marked by two episodes during the month—one, the dangerous illness of the prisoner, and the other, the trial and condemnation of Col. Stoffel for disrespectful language towards the public prosecutors while giving his testimony before the court.

In the preliminary elections recently held in Prussia, the progressists carried the city of Berlin; the liberals were generally successful in west Prussia, Hanover, and Silesia; the clericals carried Minster.—Prince Bismarck was reappointed president of the Prussian ministry late in October, in place of Gen. Von Roon, and it is understood that Bismarck's restoration carries with it the effective control of the whole cabinet, which he demanded previous to his resignation. This indicates that the clerical party had received a more severe check than even the elections would imply; nor have the first acts of that minister tended to reanimate their hopes, he having resolved, it is said, to summon the Roman Catholic bishops, who refuse to comply with the government measures, to tender their resignations. Count Von Roon was subsequently removed from the ministry of war of Prussia, his successor being Lieut. Gen. Von Kameke.

Greenland is reported suffering from a famine so severe as to threaten to depopulate the country, caused by a failure of the fisheries. In one small village upwards of 150 persons are reported to have already perished.

Holland has become aware that a rendition treaty between that country and the United States is a necessity, and on November 11th the minister of justice officially informed the chamber of deputies of the fact, and urged immediate action, in view of the rapidly increasing intercourse between the two countries.

Nothing definite is known concerning the present position of affairs in the Ashantee country. Sir Garnet Wolselsy arrived at Cape Coast Castle late in October, and it was semi-officially reported that he went with instructions to offer the Ashantees peace, on condition that they lay down their arms and withdraw from the territory. If Sir Garnet offered these terms, the Ashantees do not seem to have accepted them, as preparations for carrying on the war continue.

The trial of the celebrated Tichborne claimant for perjury bids fair to outlast that of Bazaine. It has now been adjourned to await the arrival of about twenty witnesses from New York, and other adjournments are probable. The testimony of the defence has just been put in, and a long siege at rebutting this evidence may be expected.

The Jesuits vacated the premises lately confiscated by the Italian government November 2d, and scattered to various parts of the world, the "general" retiring to Belgium. November 4th, an order was promulgated suppressing four convents in the city of Rome. The plan adopted by the government shows the spirit of the age, being accomplished with as much mildness as possible, and none the less efficacious on that account, nor the less likely to prove permanent.—The Italian parliament was opened on November 15th, by the king in person, who himself delivered the royal speech. He alluded to the present attitude of the pope, and said that while he respected both the vicegerent and his religious opinions, and would see that his liberty was not infringed, he would not permit attacks upon the nation or its institutions. He also asked for legislation to perfect the organization and efficiency of the army and navy, and to improve the finances. The speech was greeted with frequent outbursts of applause.

——The survey of the Pacific ocean by order of the U. S. government, for the purpose of determining the geodesy of its bed, has thus far developed the fact that it is totally different from that of the Atlantic. Thirty-four soundings have been made in a distance of 1,000 miles west from Cape Flattery, Washington territory, and there was discovered in this distance a mountain 2,400 feet high, the grade on the eastern slope being 124 feet to the lineal mile. On the western slope, however, the descent was only 6 feet to the mile, and continued at this rate until the greatest depth, thus far—15,204 feet—was reached. The greatest depth of the Atlantic between Newfoundland and Ireland is about 12,000 feet. The bottom found is described as blue, black, and brown mud, with occasional mixtures of gravel and shell. The Atlantic basin is mostly of brown mud, such as, dried, forms the chalk cliffs of Dover. The purpose of the soundings is mainly to ascertain the feasibility of laying a submarine cable between the United States and Japan and China. Government surveyors have also been engaged during the entire season in establishing the Northwest boundary. The line has been advanced as far west as the Big Muddy, a branch of the Missouri river, which crosses the line at a point about 200 miles east of the Rocky mountains, and 450 miles west of Pembina, Minn. The country is dangerous by reason of bands of roving Indians, and the surveyors had to be escorted by troops. The surveys will be resumed in the spring.

——According to information from official sources, it appears that at the close of the fiscal year, June 30, there were 32,672 American vessels, with an aggregate tonnage of 4,696,026—being an increase, as compared with the previous fiscal year, of 19,493 tons in the foreign trade, and 236,668 tons in the coastwise trade; three-fifths of the total increase of tonnage being in canal boats and barges. The vessels built during the past year, were: Sailing, 144,629 tons; steam, 88,011 tons; and 126,606 tonnage of canal boats and barges; 26 iron vessels, 26,500 tons.

——Congress will, it is said, be asked for an appropriation at its approaching session to pay the awards in favor of the English, made by the Anglo-American commission that has been in session for nearly two years past at Newport. The amount required is not stated, but is understood not to be large. The agreement is, that the payment is to be made to the agent of the English government, for distribution among the claimants September 26, 1874.

——The grape and wine crop of California promises to be deficient in quantity, though much excelling in quality that produced last year. About 5,000,000 gallons of wine were produced last year, and the yield this year is estimated under 3,000,000 gallons. The cause of this deficiency is reported to be late frosts and excessively hot weather later in the season.

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UNIFORM RAILWAY TIME.

AS the country is crossed by a closer network of roads; as their traffic multiplies, and travel still increases, a higher order of executive skill is daily demanded in their management. As railroads have become an interest of supreme national importance, they have attracted to themselves a large proportion of business talent, which a few years since would have been drawn into other channels; so that we now commonly meet in those responsible for their superintendence, not only the practical knowledge and energy which have in many cases carried their possessor up from the ranks, but the educated ability which has of late years been drawn to the higher responsibilities of railroad management, by the increasing honor and profit attending them.

If, then, it is unhappily true that with the increase of traffic, which almost blocks our principal roads, collisions have multiplied, and were never relatively more frequent and disastrous, this must be attributed rather to an imperfect system, inherited from a day of small things, than to defective ability in the management; and it is to the educated intelligence which has been alluded to, that an appeal for a remedy is here addressed, in pointing out, as it seems to the writer, at least one remediable source of the evil.

If we could make a model of the country, with all its railroad systems, of a size which the eye could embrace; with its rolling stock and miniature trains, driven by one central piece of clock-work, we should see them moving in what would look, on some of the main lines, like a frequently broken procession covering the entire length of the road. We should see, if our model reproduced in motion all that occurs in reality, occasional accidents and mimic disasters; but, probably, if the eye could thus grasp at once all the immense movement of freight and passenger transfer of the country, the surprise would be, not that disasters were so frequent, but that they were so few. One important difference, however, there would be, to the advantage of the model, in which an entire class of accidents would be found to have disappeared. The mimic trains might occasionally run off their tracks or stop, but, except when due to some such cause, *collisions* would be absent. Each train would be at the appointed place at the appointed time, when all were moved by *one* piece of clock-work; the relative distance between trains would never be exceeded or diminished; none would be on the main track when it should have been on a siding; there would be no conductors' watches to go wrong;—in short, the whole of that large class of accidents depending upon errors or mistakes as to *time* would be avoided.

We have, in considering such a model, shown the possible remedy for a similar class of real accidents, or rather a direction for our efforts in seeking one. If we do, in fact, and not in name, make "things move like clock-work" on the real road, we shall eliminate, not all dangers or delays, but a most material part of them.

As every superintendent proposes to himself to do exactly this now, as far as he can, it will be well to ask where the shortcomings are in practice, since they so undoubtedly exist. And first, considering the roads of the country as a whole, we see an essential point of inferiority in our working system, in the fact that, instead of our trains being moved by one standard, they are run by many differing times—"Portland Time," "Boston Time," "New York Time," "Philadelphia Time," "Altoona Time," "Columbus Time," "Indianapolis Time," "St. Louis Time." This wearisome iteration does not enumerate the different standards of time employed, until lately, along one single line of travel. The number of wholly differing local times used to run our roads by, is uncertain, but that over fifty such are in use to-day would be an assertion which keeps much within the limits of fact.

Imagine that in the model representing the railroads of the country we took away our single piece of clock-work, and substituted fifty wholly independent ones in its place, introducing complexity and discord in the place of simplicity and unity; imagine this, and we conceive exactly the irrationality of what we are now doing. When the first railroad was built, the telegraph was practically unknown, and the introduction of local times and varying standards for railroad use might have been tolerated as a temporary evil. What an example of the disposition of men to acquiesce in any established practice, that we should still be running by them to-day!

There is probably no valid objection to be urged against uniting all the local times of the continent into one for railroad use; but, if this appears a too radical change, there should, it would seem, be no doubt about the gain in having a common "railway time" for the country east of the Mississippi, doing away with all the discrepancies which perplex travellers, all the added trouble to the superintendent in preparing schedules, and all the facilities for making error, of the actual no-system. The difficulty is undervalued, because, if the present local times were as accurately kept as they are meant to be, and supposed to be, there would be no such great harm; and most superintendents or managers keeping a good regulating clock in their principal office, and being sure that its time is uniform, mistakenly assume that it is correct. Clocks, however good time-keepers, have no power to keep *themselves* right, and are in practice adjusted occasionally by some jeweller or watchmaker, whose business it is supposed to be to know the exact time. But it will be found that in most large cities the regulators of the different jewellers differ widely from each other. The ordinary variations in such supposedly accurate standards would certainly surprise most of their possessors, as it is almost sure from trial, that of any twenty, no two agree. The reason is not far to seek, and it lies in the fact that all time is derived, in the first instance, from astronomical observations, and no time is accurate except when it is kept so by constant comparison with the stars.* This practice is now the rare exception rather than the rule, and though some few watchmakers have shown a commendable wish for accuracy, by attempting astronomical observations for themselves, it is probable that they would be quite ready to agree that such matters, like any others, are best in the hands of those persons whose time is specially devoted to them. If we had it all to begin anew, probably the best system for the railroads of the country would be, as now, to make some good clock in the principal office of the road the official standard—the time for each road thus coming under the eye of its superintendent—but to regulate these standards daily from one absolutely accurate clock, which would automatically signal the same time, at a certain minute of each day, over all the railroad telegraph wires of the country, or, at any rate, of all the country east of the Mississippi. The purpose of this article, in advocating such a system, is to exhibit it, not as a mere possibility, but as it actually exists in daily service over the Pennsylvania Central road, and its leased and associate lines, from New York to Chicago.

It will be remembered that three points are to be kept in view: first, as to the unity of the standard; second, as to the accuracy of the standard; and third, as to the facility of comparison.

There is in the Transit-room of the Allegheny observatory, at Pittsburgh, a clock of specially accurate construction, set to keep mean time, and by mechanism to be directly described, capable of transmitting by electricity the time shown by its face to any point. By this clock, all clocks in superintendents' offices, all station clocks, all conductors' watches on the United Railroads of New Jersey, the Pennsylvania Central railroad, the Pittsburgh, Fort Wayne and Chicago, the Pittsburgh, Cincinnati and St. Louis, as well as numerous others, are regulated. The consideration of this unity is here placed even before that of accuracy, because it would be better in practice to adjust the time of the country by *one* clock, even though it were an indifferent one, than by any number of differing good ones. The highest accuracy is nevertheless, of course, to be desired, and it is believed to be obtained. There are many other astronomical clocks in the observatory, and much subsidiary apparatus which need not be here explained; but the principle by which such accuracy is reached is very simple in conception. We may imagine a large and powerful telescope bolted against a massive pier of stone, and directed to the heavens at such a height that, if the earth stood still, some particular fixed star would remain permanently in view, at the intersection of the cross hairs. Since the earth revolves, the telescope, which is unchangeably fixed in the meridian, will sweep round with it, and its cross hairs pass over the star at every diurnal revolution—the exact time of their so doing being compared with the clock, which is thus daily regulated. In practice the system is more intricate than in principle, calling, for its most successful development, on many ingenious and beautiful pieces of adjunctory mechanism; such, for instance, as the chronograph, which, by the aid of electricity, records the time that the clock keeps, at the instant the telescope passes the star, to the hundredth part of a second. There are three time-keepers of the highest class in the observatory, besides the one we have described, which are themselves regulated by the stars, and with each of which the standard is also daily compared. This instrument is, like any other clock, subject to error, though the errors are very small; minute as they are, they have a real existence, however, and the observations detect them; they are found to vary from one-tenth to one-fourth of a second daily; and these little errors, even in the case of so fine an instrument, would rapidly accumulate, were it not for the check of daily observations. The standard has these very minute deviations corrected as they arise, by incessant comparisons with the stars; and the earth itself, then, turning uniformly on its axis, is in reality the clock with which the time of these railroads is compared every day.

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* The regulating clocks of three important communicating roads were lately observed to be in disaccordance with one another to the amount of five minutes, after allowing for the differences in local time. In another case, several lines of railroad were found to derive their time from a jeweller who adjusted *his* "regulator" by a sun-dial, by which, clocks, supposed to be accurate to a second, were regulated in turn, and by whose grossly rude indications, at second hand, trains were run over some hundred miles of road. These are ordinary instances; more extreme ones might be found.

So much, very briefly, for the accuracy of the time furnished. It remains to speak of the facilities for its comparison. Four lines of telegraph enter the observatory, one of which connects with the railroad wires. The circuit is led through the standard clock, in which a wheel with 60 teeth revolves once a minute. One of the gold terminals of the wires is in contact with a jewel, which is moved slightly every second by a passing tooth. At this instant the circuit is broken, and by filing away some of the teeth certain beats may be omitted, to designate the end of the minute, while another piece of mechanism holds the circuit open for the last minute in each hour. The action is purely automatic and continuous, and the clock-beats are repeated through the twenty-four hours in the principal offices at Pittsburgh, with which they are united by a line specially devoted to their use. At a certain hour the current is switched into the main circuit, and then the clock may virtually be heard ticking in New York and Chicago, and at every intermediate station, at the same instant. The system has been in use, as the official standard of the Pennsylvania Central railroad and its eastern connections, for some years; more recently it has been extended to the western roads. The aggregate length of main and branch lines thus supplied is several thousand miles, and the convenience of the system may be considered to have thus been sufficiently demonstrated. The numerous "regulators" of the principal offices are retained in use, serving to test the uniformity of the time distributed. No systematic error of the primary standard is possible, when that primary standard is in fact the revolution of the earth itself; no accidental error has presented itself thus far, nor is there a likelihood that any will. If any such *should* occur, the subsidiary clocks along the road are, of course, capable of detecting any sudden change.

The system has been in use for some years, and as the aggregate length of the roads making this their official standard is now, as has been stated, several thousand miles, its utility may be considered as settled. The ordinary sounders of a line serve, without adjustment, to transmit the time; and at the order of the director of the observatory, and on application of any railroad superintendent, it can be introduced at an hour's notice, no special apparatus being indispensable. In one respect the system falls short of attainable simplicity, there still being two standards of time in use (Philadelphia and Columbus), and the clock being arranged to send Philadelphia time to the eastern roads, and Columbus time to the western. These, it may be hoped, will ultimately be exchanged for one.

Every working observatory keeps, for its scientific purposes, the time determined with great precision, whether it is needed outside its walls or not, and it is therefore nearly as easy to supply it to a second, as to supply it at all. While no one, of course, will object to such exactness, it may naturally be thought superfluous for ordinary needs. It is believed, however, that this accuracy is not superfluous, and this for a reason that commands assent, if we recognize that there may be a gain which can never appear in printed returns, and yet be none the less real.

We may change the wording of the old proverb, "Take care of the pence, and the pounds will take care of themselves," to "Take care of the seconds, and the minutes will take care of themselves," without changing its spirit. Habits of accuracy, as well as habits of thrift, are formed in much the same way. Where real exactness is easy, it grows habitual, and the familiarity of the employés of a road with a system in which *habits* of accuracy as to time are insensibly formed, furnishes the best guarantee of their attention to those general orders of the superintendent, on which the security of life aud property depends. From the writer's observation, he has been led to think that the advantage gained in this respect is among the most important the system presents, though it is one that cannot be estimated in figures.

The attention of the managers of the Pennsylvania Central railroad was first pointedly called to the utility of some such system as that described, by Wm. Thaw, Esq., now vice-president of the Pennsylvania company, to whom its practical advantages were early apparent; and if any credit attach to the introduction of the system here, it is to him that it belongs.

There are several observatories in the country which are engaged to a greater or less extent in similar work, and any of these would probably be willing to supply any railroad with the exact time, at any rate, of its own locality; while it is believed that it is the common wish of their scientific directors to see the spread of some such system as that which unites all the English railways, and which, under forms essentially the same, all will be ready to extend here. The initiation and superintendence of the scientific portion of the details of the system described in the present article have rested with Prof. S. P. Langley, the director of the Allegheny observatory, at Pittsburgh, who desires it to be known that the authorities of the roads now employing it do not aim to restrict its advantages to the use of any company or corporation.

DEPENDENCE OF VEGETATION ON THE WINDS.

SUSPENDED within the aerial ocean that bathes the earth lies a second of aqueous vapor. So thoroughly does this second ocean partake of the motions and peculiarities of the first, and share in its general phenomena, that it almost ceases to have an identity of its own. And yet, in many respects, its properties are radically different. The one is composed of an easily condensed vapor; the other mainly of incoercible gases. The one is confined to within a few miles of the sea-level; the other reaches certainly fifty miles above it, probably much farther. The quantity and extent of the one is subject to extended changes, while that of the other is within certain limits kept invariable. While the weight of a given bulk of the one increases with an increase of the temperature, that of the other steadily decreases. Nor have these two oceans any necessary connection. Though so intimately associated, either may exist independently of its neighbor, and, in reality, does exist as if it alone were present.

Though the aerial ocean vastly exceeeds the vapory one in its size, it does so by no means in its importance. Animal and vegetable life are dependent for their existence upon each of these oceans; but variations in either their variety or luxuriance are more certainly followed by a deficiency in the one than in the other; especially is this the case in the vegetable kingdom. For it the main wealth of the atmosphere is found in its varying quantity of watery vapor. Other things being equal, the presence of a sufficient quantity of vapor in the air is a guarantee of a vigorous, luxuriant vegetation; and this independently of the nature of the soil. On the other hand, no matter how favorable the conditions of soil, light, and heat, if the watery vapor be absent, sterility abounds. But to this we will revert shortly.

Though the presence of watery vapor is necessary to the well-being and existence of the animal kingdom, the necessity is by no means as absolute as with vegetation; not that animals need water for their growth less than plants, but from their powers of locomotion, failing to secure the necessary pabulum in one locality, they are enabled to seek it in another. Hence, while the absence of watery vapor is followed by the death of the vegetable world, quite a vigorous animal life is compatible with its almost total absence. Indeed, within certain limits the two kingdoms are different in this respect. The deserts of Arabia and Africa are destitute of vegetation, but are the haunts of the kingly lion and the fierce tiger, that are among the most perfectly developed and highly organized of the mammalia. True, many of the lower types of animal life exist more numerously in the presence of abundant moisture. This is essentially true of the whole insect world. Nowhere on the earth is there such a copious abundance of moisture throughout the entire year as in that part of South America traversed by the Amazon and its tributaries, and here the insect world attains its most perfect development: The Coleoptera, the Orthoptera, and the Lepidoptera, surprise us not only by their marvellous variety, but also by their thousands of variegated hues. The lower forms of the vertebrates also require abundant moisture, such as the crocodiles, lizzards, and serpents, and in this respect approach the vegetable type of life. It is only the higher animal life that thus departs in its requirements from those of the vegetable world.

We purpose in this article to discuss the laws that govern the distribution of vegetation over the earth's surface; to account for its presence in one locality, and its absence in another. To obtain a clear insight into these laws it is necessary to study the conditions necessary for the vigorous growth of vegetation in all its varieties. Plants require, as we know, certain conditions of light, heat, soil, and moisture, and their presence in any locality is a witness of these conditions having been fulfilled. Each plant has conditions peculiar to itself, and it is only when these have been thoroughly ascertained that we can speak certainly as to its distribution. Our object at present is, however, quite distinct from this. We allude simply to the distribution of plants in general, and not in particular; we wish to point out those general laws that require the presence of vegetation in any given portion of the earth without any more than asserting the general form to which the plant shall belong. Our study must here deal with general laws; all special ones must be discarded. Nor will the scope of our present article allow us to inquire as to the effect produced by variations in the nature of the soil, on the particular species of plants that it is capable of supporting. We shall confine ourselves almost entirely to the influence that heat and moisture play in the distribution of vegetation.

A safe criterion of the material necessary for the growth of plants is obtained from an analysis of their composition. What the plant needs for its growth it absorbs from the air and the soil, and, although part is afterwards rejected, whatever remains in its structure must clearly be present in the air or soil, either directly or combined in such a manner with other materials as to admit of its appropriation by the plant. A careful study in this direction will reveal what may be a matter of surprise to many, viz., that the quantity of solid matter present in the plant bears a small value when compared to the quantity of water. The inference is consequently unavoidable, the moisture of the soil forms a much more important function for the plant's growth than does its mineral constituents; and this conclusion is all the more strengthened when we find that by far the greater part of the solid contents of the plant are derived from the air, leaving the quantity of material withdrawn by the plant from the soil, and appropriated to its own structure, exceedingly small. That the varying constituents of the soil exert an important influence on the vegetation, though so small a quantity is withdrawn from it, is a matter of every-day experience, and is seen in the inability of certain soils to produce more than a given number of crops of a particular species, unless the elements abstracted from the soils are returned by manures, composts, or other means. But this influence is very unimportant compared with that of the quantity of moisture. If the question be simply whether any vegetation is to exist without limiting it to a particular kind, then the nature of the soil becomes of but secondary importance; for, given the other conditions of light, heat, and moisture, some species of plant is certain to appear and thrive. The requirements of vegetable life are so varied as regards their mineral constituents that, given the other conditions, almost any kind of soil will be that best suited for some particular plant species. Besides, it must not be forgotten that we are now considering the distribution of those plant species that are tended by nature, and not by man—of those that spring up spontaneously as it were, and are not planted. Here whatever is taken from the soil is restored to it again on the death and decomposition of the plant. The composition of the soil is thus kept constant, or at least nearly so. In point of fact its richness, and consequent ability to sustain vegetable life, are increasing, not decreasing, since the plant is adding to the nourishing power of the soil by abstracting ammonia, nitric acid, and carbonic acid, or their derivatives from the air, or decomposing fresh mineral matters from the soil, and fitting it to sustain a higher, more vigorous life. The artificial growth of plants is destructive in its tendencies—it is self-destroying; the natural growth is self-sustaining.

The presence of sufficient moisture, then, being the most important condition for the vigorous growth of the plant, let us now inquire as to the laws which govern its distribution. All the water which moistens the earth's surface, which issues from its body as springs, which is collected over its surface as lakes or inland seas, or which flows through its rivers toward the ocean, has come at one time or another directly from the ocean. It has been, through the heat of the sun, raised from the oceans and transferred into the ocean of aqueous vapor, that we have already spoken of as suspended within the aerial ocean. From this ocean it has been precipitated as rain, hail, snow, or dew—mainly the first. The total quantity of water discharged during any day into the ocean by all the rivers and lakes of the earth, is a measure of a single day's rain fall for the land area of the earth. Taking the area of the earth's water surface as three times greater than the land area, the total discharge during any day from the ocean of aqueous vapor is roughly four times the total quantity of water poured by all the rivers into the ocean. This quantity is enormous, and serves to give us at once an insight into the value and importance to the world of the distribution of aqueous vapor. The starting point of the vapor is, then, the ocean, and this is also the place to which it returns. Let us trace it rapidly in its circular route, and endeavor at the same time to note the peculiarities.

The sun's heat falling on a water surface converts a part of it into a vapor, which rises into and is diffused through the atmosphere, in obedience to the same laws that govern the mingling of gases. Within a certain limit this vapor remains invisible, and cannot be distinguished from the main bulk of the air. At every temperature the air is capable of holding in an invisible condition a definite quantity of vapor. The warmer the air the more it can hold. But for every temperature there is a point, beyond which it is impossible for more vapor to pass it. This point is called the point of saturation, or the dew point. When the air has reached its dew point, and its temperature is increased, no visible effect is produced—its capacity for moisture is simply increased; but, if its temperature be lowered, then it is no longer capable of holding all its moisture, and the surplus becomes visible in some form or other of precipitation, viz., as fog, cloud, dew, rain, hail, or snow. In order to account, then, for any precipitation of moisture, it is necessary first that a sufficient quantity of vapor pass into the air to bring it to its dew point, and then that the temperature be lowered. The quantity of moisture thus precipitated will clearly depend upon two circumstances, viz., the temperature of the air when the dew point is reached, and the temperature to which it was subsequently lowered. The higher the one and the lower the other, the greater will be the precipitation.

The means by which the lowering of the temperature can be accomplished are varied. A warm vapor-laden air may blow into a cold region, and thus have its temperature lowered sufficiently below the dew point to give a considerable rainfall. A cold wind may mingle with a warm one, and thus produce a moderate shower; or powerful ascending currents may carry the moisture of the lower strata into the upper regions of the atmosphere, where the temperature is very low. We will again recur to the manner in which these various causes operate.

The deposition of the moisture of the air is, then, in all the cases we have considered, referable to motion. Let us, then, inquire as to the laws of this motion; for, upon them will depend the presence or the absence of moisture in any region, and consequently the presence or absence of vegetable life. The ocean of aqueous vapor partakes perfectly of the movements of the atmosphere. It in fact derives its movements mainly from those of its bulkier neighbor. It is to the motions of the winds, then, that we must look for the explanation of the peculiarities that attend the distribution of moisture.

When any portion of the earth's surface becomes heated, the air over that part becoming lighter, is pressed upwards by the cold and heavier air surrounding it. Thus are generated two currents—a rising current and lateral current—that blow in on all sides towards the heated area. The partial vacuum created in those parts of the earth from which these lateral currents came, induces the air from beyond to blow in, which, in its turn, imparts a motion to the air from regions still farther beyond, and thus the initial movement propagates itself backwards, or in the opposite direction in which the wind blows, and may extend to very great distances. The ascending column of air, after attaining a certain elevation, which depends upon the temperature of the heated area, flows over, and moves towards the regions left vacuous by the inrushing surface currents. These latter, however, always prevail on account of their greater weight. The unequal conflict between the upper and the lower currents continues until the former, at last grown cold and heavy by the low temperature of the upper regions, prevail and usurp the place of the surface currents. Any difference of temperature of the earth's surface will, then, cause three distinct winds or air currents, viz., an ascending current, lateral surface currents, and upper currents, whose movements are directly opposed to those of the lower currents. The strength of these movements will depend clearly upon the size of the heated area, and the difference between its temperature and that of the adjacent regions.

What thus takes place over limited regions of the earth due to local variations in temperature, occurs on a grand scale in the equatorial regions. The great difference between the temperature of the tropics and the polar regions gives rise to immense atmospheric disturbances, which effect an interchange between the air of the equator and that of the poles. A very powerful and extended rising current occurs from a belt of land stretching several degrees on both sides of the equator, though farther north than south. The partial vacuum thus created is powerful enough to propagate its influence quite to the poles, and the polar air thus rushes in towards the equator. The ascending current, in its turn, flows towards the poles, and thus result two currents of air blowing due north and south. These directions are affected by the rotation of the earth as follows: The earth moves on its axis from west to east; the wind, then, that in the equatorial regions is moving towards the poles, has acquired at the same time, through the rotation of the earth, a movement towards the east, and under the influence of two movements flows in the northern hemisphere towards the north-east, and in the southern towards the south-east; or, since we name a wind from the direction from which it comes, the upper current becomes in the northern hemisphere a south-west wind, while, in the southern hemisphere, a north-west wind. The rotatory motion of the earth at the poles is null, so that the air there is subjected simply to a motion that urges it towards the equatorial regions. But, as it continues towards the equator, it constantly reaches portions of the earth that are moving more and more rapidly towards the east. Unable to acquire this easterly motion, the polar currents lag behind, and striking successively portions of the earth more and more towards the west of the meridian on which they started, are deflected from their original course, and become north-east winds in the northern hemisphere, and south-east winds in the southern. The circulatory movements of the air, so far as we have considered them, are then quite simple. A surface current moves in each hemisphere from the poles towards the equator; in the northern hemisphere from the north-east; in the southern, from the south-east. The upper current, from the equator towards the poles, moves in the opposite directions; in the northern hemisphere from the south-west; in the southern, from the north-west. But these simple movements are modified by a variety of causes. Let us trace the action of one of the most important. The upper current does not continue as such all the way towards the poles. At varying latitudes, depending upon the heat of the equatorial belt, it falls, and continues for a while to move on towards the poles as a surface current. Over this region the polar current moves towards the equator as an upper current whenever the equatorial current prevails, and *vice versa*. The region is marked by constant struggles between the equatorial and the polar winds; in general, the former prevail. In higher latitudes the polar currents are most always the surface winds, the equatorial currents again moving as upper winds. The region that witnesses this interchange between the upper and the lower currents is variable, but lies in the neighborhood of 40° and 67° latitude, on both sides of the equator. The simple movement of the atmospheric circulation, to which we have just referred, is there modified by the interchange between the north-east and the south-west winds in the northern hemisphere, and the south-east and north-west in the southern. Where the ascending current is the strongest, no motion of air is experienced. This region is hence called the zone of calms. It lies mainly north of the equator, reaching as high as latitude 11° 30′ north. Immediately adjoining the zone of calms, on both sides of the equator, is a region marked by a remarkable uniformity in the direction of the winds during all seasons. This constitutes the well-known region of the trades. Their direction in the northern hemisphere is north-east; in the southern, south-east. The trades owe their uniformity to the fact that the equator is always the hottest region of the earth. They owe their varying extent to the band of greatest heat lying sometimes north and sometimes south of the equator. It therefore happens that their limit in the northern hemisphere reaches farther to the north during the summer months, while it retreats during the winter. The region that embraces the winter and summer limits of the trades is known as the sub-tropical wind zone. Here the polar currents prevail in summer, the equatorial in winter. The sub-tropical wind zone must, however, be carefully distinguished from that which immediately adjoins it, viz., the zone of the variable winds, for, in the sub-tropical zone the trades always prevail in summer, and the variables always in winter; while, in the variable wind zone, the equatorial or the polar currents may become surface winds indifferently at any time of the year, or at any hour of the day or night. The sub-tropical zone is, then, characterized by periodical winds; the variable zone by non-periodical winds. It should, however, be carefully borne in mind that this zone, though styled variable, experiences winds much more frequently from the west than from the east. In this zone south-west winds generally prevail in the northern hemisphere, and north-west winds in the southern. Beyond the limits of the variables there lies a region whose prevailing winds are from the poles. This region is appropriately styled the polar region. In the northern hemisphere its winds come from the north-east; in the southern, from the south-east.

Such, then, briefly, is the general distribution of the winds. These general directions are still further modified by a variety of circumstances. The unequal heating of different portions of the earth's surface, arising from its elevation above the sea, the general direction of its slope, the distribution of its land and water areas, the varying nature of its soil and vegetable covering, and other causes, produce local ascending currents that deflect the regular winds from their customary directions. The outlines of the continents, and the positions of their mountain ranges, with their interlying valleys, offer in certain directions easy access to the winds, and still further modify their movements.

One of the most important of these modifying influences, and at the same time the most general, is the deflection of the trade winds along the coasts of the continents, arising from the unequal heating of the land and water. The operation of this cause is best understood by what takes place along the shore of every island during the warm months. The sea heats more slowly than the land; at the same time it parts with its heat more slowly; consequently, during the daytime the land soon grows hotter than the water, and an ascending current ensues which causes the air to blow in from the sea: this constitutes the sea breeze. At night, however, the land becomes colder than the sea, the ascending current rises from the sea, and the cold air rushing in from the land constitutes the land breeze. Now, this periodical interchange between the air of the sea and land, that is caused by their daily differences of temperature, occurs on a grander scale between the continents and their neighboring oceans, on account of their yearly differences of temperature, or the difference between their summer and winter months. During the hotter half of the year the ascending current rises from the land, the air blowing in from the sea; while, during the cooler half, the motions are reversed. These winds occur with great regularity in some parts of the world, and are styled monsoons, or seasonal winds. There are three well-known regions where they occur, viz., the gulf of Mexico, the gulf of Guinea, and the Indian ocean.

Over the coast of Upper Guinea, reaching as far inland as the Kong mountains, south-west winds prevail during the warmer half of the year; the north-east trade prevails during the cooler half. The deflection of the trade is occasioned by the great heat of the immense desert of Sahara, which thus produces an inrushing of the wind from the occan. In the Indian ocean the monsoons prevail both north and south of the equator. In the northern hemisphere they are occasioned by the overheating of the Asiatic continent. Their directions are south-west in summer, and north-east in winter. The Himalaya mountains mark the northern limit of the summer monsoon; in the southern hemisphere the large continental island of Australia is the disturbing cause. The south-east trade is deflected, and becomes during the summer months of this hemisphere a north-west wind.

Besides these modifications of the trade winds, there exist, over various portions of the earth, winds that owe their origin to local causes; these are called local winds. Such are the various desert winds caused by the overheating of a large tract of land devoid of vegetation—the cold winds that originate around the snowy summits and glacial-clad valleys of high mountains.

Having thus obtained an insight into the general movements of the atmosphere and its burden of aqueous vapor, let us now inquire in what manner and under what circumstances this vapor is deposited. We have seen that the quantity of vapor the air is capable of holding increases with an increase of the temperature; while the quantity it can deposit increases with a decrease of the temperature. The circumstances, then, that favor a great deposit of vapor are, first, sufficient heat to evaporate a large quantity of water, and distribute it through the atmosphere; and, second, a sufficient reduction of the temperature to render the air incapable of retaining a considerable proportion of its vapor. Warm winds that are moving towards cold regions, fulfil all the conditions requisite for copious precipitation, since they are already, under favorable circumstances, saturated with moisture, and are continually having their temperature decreased, and consequently their capacity for moisture. On the contrary, cold winds that are moving towards warm regions, fulfil these conditions but imperfectly, since from their temperature the probabilities of their containing moisture are very slight; and even if they should contain it, their temperature being always on the increase, their capacity is also increased, and they not only retain what they have, but readily take more from the countries over which they pass. The winds, then, in either hemisphere, that blow from the equator towards the poles are essentially moist, wet winds, while those that blow from the poles to the equator are dry winds. We should expect, then, in the northern hemisphere to find the north-east wind dry, the south-west wind wet; while, in the southern, the south-east wind should be dry, and the north-west wind wet. The trade winds, then, are dry; the variables wet. In brief, the equatorial currents bring the rains, the polar currents the droughts. It must be borne in mind, however, that these are but general laws, and are subject to very great modifications. Thus it is true that, in general, the trades are drying winds; but, when they have blown over a great expanse of ocean, and strike against the cold coast of a continent, they are capable of producing very heavy rain-falls. This is especially the case in the tropics. Long before they have crossed the ocean, they have even their very great capacity for moisture satisfied, and they arrive at the other side fairly saturated with moisture, and require but a slight decrease of temperature to give copious showers. Keeping in mind these preliminary principles, let us now inquire as to the character of the rain-fall in each of the wind zones.

In the zone of calms—the zone marked by the equatorial ascending current—it rains every day. Generally the early mornings are clear; towards the middle of the day very heavy showers occur; it then clears off towards night, when seldom, if ever, does rain fall. The explanation is simple. Here the deposition of moisture is occasioned by the ascending current, which, hurrying the moisture of the lower strata into higher regions, thus reduces its temperature below the dew point. During the night and in the forenoon the ground is not sufficiently heated to cause the ascending current to rise high enough to condense the moisture, but in the middle of the day the heat is greater and the upward current strongest.

In the zones of the trades, the winds, in consequence of their directions, are naturally dry; still, during their long journey to the boundaries of the zone, they have acquired no little moisture, and need only a strong ascending current to give heavy rains. This current is powerful enough only during the summer months, at which time the rains prevail. In the sub-tropical zone the rains occur only during the prevalence of the equatorial current as a surface wind; hence the rainy season occurs in winter. The three wind zones we have just named, viz., the zone of calms, of the trades, and the sub-tropicals, are all three characterized by periodical rain-fall. The remaining zones may have rain at any season of the year, and at any hour of the day or night.

One of the most prolific causes of rain is found in the chilling action on a moist wind when it strikes the coast of a continent. During its oceanic transit, no matter what its direction, it becomes heavily laden with moisture, and requires but a slight reduction of temperature to produce considerable rains. Especially is this the case if a high plateau or mountain range oppose itself to the progress of the wind. No cause is more certain to insure the mounting of the air into the upper regions. Urged by the onward motion of the wind behind it, the air is forced to creep slowly up the mountain's side, and hence bathes its flanks and summit in heavy rains. Witness the heavy rain-falls of eastern South America, produced by the chilling of the trades by the Andes, or the equally heavy rains caused by the condensation of the moisture in the monsoons, consequent on their crossing the mountains of Hindoostan. Should the vapor-laden wind, however, pass over a very warm tract of land, as for example a large desert, then no rain results, as no chilling is produced. Heavy, dark clouds, roll over the Sahara from the warm Mediterranean, but only disappoint the thirsty traveller, as they are quickly dissipated by the warm air rising from the heated sand.

Having now obtained some little insight into the laws of the distribution of the winds and moisture, we shall show that the peculiarities of the vegetation of any region may be fairly inferred from the quantity of its annual rain-fall and its distribution throughout the year. Since plants differ in these requirements of heat and moisture, and these are distributed over the earth in accordance with fixed laws, the distribution of plant life should be equally fixed. Heat and moisture, the main requisites for vegetation, are greatest at the equator, and decrease in general regularly towards the poles. Accordingly we find the same decrease in the luxuriance and variety of vegetation. Nowhere does vegetation grow so vigorously as within the tropics. Here it displays a dazzling splendor, a marvellous variety. The humble grasses of our meadows tower 60 feet and upwards, and become the bamboo, real trees. Forest trees assume a size, denseness of foliage, unknown in temperate climes. In number of species, as well as in size of individuals, the same wonderful richness meets us. According to Guyot, while the temperate zones of both Americas furnish scarcely more than 4,000 species of plants, the tropical regions of the same continents give 13,000 known species; and this, too, despite the little that is known of the flora of immense unexplored tracts of land. But not all portions of the tropics are characterized by the same luxuriance. Over large tracts of land no rain falls, and here the vegetation is also absent. Witness the terrible drought and sterility of the mighty Sahara, of the Arabian peninsula, of Atacama, or of Mexico. Over others the supply is meagre and the vegetation scanty. The shore lines of the continents, and especially of tropical islands within the regions of the monsoons, receive copious supplies of moisture. The islands of the Malay archipelago are in general especially favored in this respect; and we accordingly find such islands as Sumatra, Borneo, Papua, the Philippines, the Moluccas, and the uncultivated portions of Java and Celebes, clothed with dense virgin forests that reach from the sea-level to the summits of the loftiest mountains. The mighty rivers of Hindoostan, the Ganges, the Brahmapootra, the Indus, the Irrawaddy, all bespeak the copious rain-fall, and prepare us for the dense forests and vegetation of the mountain summits. Even continental Africa, shut in elsewhere by her mountain ranges, receives in the Soudan an abundant rain-fall, as is witnessed by the Niger and the Nile, and here supports a vigorous vegetation.

In our own hemisphere the trackless virgin forests of the tropical region of the South American continent bear unmistakable testimony to the law we have been tracing. From the position of the continent, the slope of the land, its contour and surface elevations, it receives from the trades an abundant supply of moisture. Forced to ascend the slopes of the mighty Andes, the winds are completely robbed of their liquid treasures, and bathe the eastern summits in continual rains. Nowhere else in the world do the rivers assume such immense proportions. Witness the Amazon, the queen of all rivers, with its tributaries, the Ucayale, the Rio Purus, the Madera, and countless others—mighty rivers in themselves—all pouring their treasures into the same valley. Here floods, 40 feet and upwards, are common, and the immense plains of the Orinoco and the Amazon assume the appearance of vast inland seas. Side by side with this lavish display of moisture is seen the marvellous wealth of the vegetable world. Thousands of square miles of land are covered with unbroken tracks of forests, so dense, so gigantic, and so intertwined with creeping and climbing plants, that, save where the mighty rivers have excluded the encroaching vegetation, and roll on under the leafy canopies, the foot of civilized man has never penetrated. The reign of the vegetable world is supreme. Even the animal world, except in its lowest type, is excluded.

But it is not only upon variations in the quantity of moisture that the luxuriance and character of the vegetation of a district depends. Variations are also produced by the different distribution of the moisture throughout the year. Forest trees, for example, require an abundant rain-fall, but require also that this rain-fall be distributed uniformly in time. It is not sufficient to secure to them a certain quantity of moisture; it is equally necessary to their growth that they be left for no considerable portion of the year without plentiful supplies of their watery food. Therefore it is that the periodical rain zones of the earth are not, as a rule, the forest zones, since here the absence of moisture during the dry season or seasons prohibits the existence of extensive forests, except along coast lines, or the alluvial flats of rivers. It is within the temperate regions that the forests thrive. Here the rain-falls are well distributed, for no protracted period is moisture lacking, while the rain-fall of different months is nearly the same. Tracts of land subjected to sharply marked contrasts of rain fall during different seasons of the year, can never support a vegetation more vigorous than low shrubs or grasses. Moderately plentiful, but irregularly distributed rain-fall, are the conditions favorable to meadows or prairies. The llanos of the Orinoco or the pampas of the La Platte are excellent illustrations of the law. Here, during the dry season, these extensive plains assume all the appearance of deserts; but, upon the reappearance of the rainy season, become clothed with a vegetation whose luxuriance is all the more striking from the contrast with its former appearance. The vast prairies of the United States illustrate the same law, though the irregularities of supply of moisture are not so decided, nor the contrasts of the vegetation of different seasons so marked.

The possibility within the tropics of the continued luxuriance of vegetation in regions where, for month after month no rain falls, may occasion surprise, and at first seem at variance with the preceding principles. But plants may rob the air of its moisture, even where no visible precipitation occurs, and the abundant store always present in the atmosphere affords ample provision for the long drought, a fractional part of which, in temperate zones, would occasion the total extinction of vegetation.

IRRIGATION IN THE TERRITORIES.

DURING the past few years, the trans-Missouri States and territories have been rapidly filling up, until about all of Uncle Sam's available domain has been taken. Throughout the territories of the Rocky Mountain region, farmers have settled along the streams where it has been safe to dwell, and are cultivating the soil. One fact, however, stares the producer in the face: the greater part of the vast region, from a point two hundred miles west of the Missouri almost to the Pacific, is arid plain and desert, with soil naturally fertile, but lacking water, and therefore barren. This area is more than one-third of the American continent, and almost the whole of it is still the public domain. The question is: What will we do with it? A large part of this region is good for grazing; the short, dry grasses are highly nutritious; and the climate, of all that portion of it lying south of the line of the Union Pacific railroad, is so mild as to allow stock to graze the year round. Stock-raising is therefore profitable, and is fast becoming a great industry. But this area is so vast that, were one-tenth of it reclaimed to agriculture, and the balance left for stock ranges, it would give to the former industry a crop-producing district greater than the entire States of Illinois, Ohio, and Missouri. It is claimed by competent hydraulic engineers, that the streams issuing from the mountains in Colorado, on the eastern slope, are sufficient to irrigate 6,000,000 acres of the plains, an arable area which, in Egypt, in the times of the Ptolemies, supplied food for 8,000,000 people. West of the Rocky Mountain range, a still greater tract could be covered by the numerous and much larger streams. And then, throughout the great West, it is expected that artesian wells, now being put down at many points, will be a practicable and universal method of irrigation.

But, an extensive system of irrigation, involving the turning of great streams from their courses, the construction of a grand canal from the Rocky mountains to the Missouri, the digging of innumerable miles of lateral canals and ditches, and the maintenance of a complete and effective system of irrigation, is beyond the private purse or the public corporation. The government is the owner of all but a very slight fraction of the area to be benefited, and the government is therefore looked upon as the proper party to inaugurate and carry out such a plan. It was with this idea in view that the governors of the trans-Missouri States and territories, accompanied by various delegations, met in convention at Denver, in October, and, after a two-days' session, during which many facts and statistics regarding the present condition and resources of the territories were brought out, framed a memorial to congress asking for a grant to each State or territory interested of one-half the government land within its borders, or the proceeds from the sale thereof, to be expended in the construction of canals and the maintenance of a national system of irrigation. How much is demanded by this memorial, and how small a proportion, comparatively, of this great West has been entered and improved, may be seen from the following table:—

	Area in Acres.	*Acres Sold and Entered.*
Arizona	72,906,240	10,000
Colorado	66,880,000	559,174
Dakota	96,596,128	458,781
Idaho	55,228,160	34,175
Kansas	52,043,520	6,351,553
Montana	92,016,640	67,785
Nebraska	48,636,800	4,573,277
Nevada	71,737,600	97,116
New Mexico	77,568,640	960
Utah	54,065,043	226,272
Wyoming	62,645,068	150,000

To aid in developing the country, the government of the United States has heretofore been exceedingly liberal in its grants and donations. There have been given from the public domain over 23,000,000 acres to railways, 75,000,000 for schools and colleges, 60,000,000 to soldiers, 12,000,000 for internal improvements, and 48,500,000 acres on account of swamp lands. It is claimed, therefore, in asking a grant for irrigation purposes, congress has already a precedent.

But, it may be asked, what is the experience, or what are the methods, cost, and the results of irrigation, in the territories, justifying the belief that there can be any general and effective national system? The following data, gathered from Utah and Colorado, will show. The former territory was first occupied in 1847, and was deemed a desert-waste—there being hardly the prospect that, even in the low valleys, any crops could be produced. James Bridger, one of the oldest of plainsmen and mountaineers, offered a thousand dollars for the first ear of ripe corn that should be raised in Salt Lake valley. The people discovered that the one thing which the soil lacked was water; so they began the construction of canals and ditches for irrigation. The result is 140,000 acres brought under cultivation, at an expense in constructing and maintaining canals of $1,500,000, an average of a little over $10 per acre. The average yield of crops is: Wheat, 23 bushels per acre; barley, 30; oats, 31; corn, 20; potatoes, 135; beets, 265; sorghum, 79 gallons; cotton, 150 pounds. The average value of crops for the past five years has been over a million dollars per year. Taking twenty-five miles of the main canals of the territory, it is ascertained that the aggregate length is 165 miles; mean width of bottom, 6½ feet; mean depth of water, 15½ inches; mean fall to the mile, 23⅞ feet; number of acres watered, 40,750. From which it may be gathered that a canal 6⅜ miles long, 6⅛ feet wide on the bottom, with 15½ inches depth of water, and with a fall of 23⅞ feet to the mile, will carry water sufficient to successfully irrigate, one season with another, 1,638 acres of cereals, vegetables, fruit, and meadow. The people of Utah have canals in every part of the territory, and are about to construct larger and longer ones than yet attempted, utilizing the waters of the Ogden, Weber, Jordan, Bear, Provo, Rio Virgen, and other streams.

In Colorado there are irrigating canals, supplying Denver, Pueblo, Colorado Springs, Longmont, Evans, Greeley, Fort Collins, and other towns, with water for trees and gardens; and throughout Arapahoe, Jefferson, Weld, Boulder, and El Paso counties, are numerous large ditchs and laterals, covering broad tracts of land. Especially is this the case along the valleys of the South Platte, Bear and Clear creeks, St. Vrain, Big Thompson, and Fountaine. The result is, over 100,000 acres brought under cultivation, and annual crops reaching $2,500,000 in value. The territory raises not only enough wheat to support its population of 125,000, but exports large quantities into the Missouri valley. The average cost of these canals and ditches has been much less than in Utah, not averaging over $7 per acre. Among the projects deemed feasible, is the turning of the waters of the South Platte into the head-waters of the Republican. This would bring under cultivation a very large portion of the plains.

Among the arguments used for the adoption of a general system of irrigation for the trans-Missouri country, is, first, that this method makes crops certain, independent of drouth, and insures, in all cases, a more plentiful yield, as has already been found in the experience of Colorado, Utah, and New Mexico; second, that the expense of irrigation does not average as much as that of clearing lands in the New England States, or as that of drainage in Illinois; third, the reservoirs that would be built near the sources of the streams in the mountains would furnish what the mines so much need—water for drainage; and fourth, the water used in irrigation is freighted with fertilizing matter held in solution, and replaces largely what the growing crops extract. Irrigation superinduces climatic changes. This is already seen in Utah. The great network of canals and artificial lakes, as well as every acre of irrigated land, is so much added to the evaporable surface of the country.

The importance of the development of this central district of the continent becomes the more apparent when we consider that it contains the nation's great gold and silver region, as well as wonderful riches in coal, iron, lead, copper, salt, and other commodities, the mining of which, and the consequent growth of extensive manufactures, would give employment to thousands, and support a population of millions, while adding materially to the wealth of the whole country. As things now stand, the limit of settlement and growth is well-nigh reached; and these great mineral deposits must remain untouched, unless the surrounding country supplies food to the toiling miners. So long as the plains withhold their gift of bread, the mountains will refuse their gift of gold.

What has already been accomplished by a meagre population in these new States and territories will serve to illustrate how great the results may be when the large agricultural area gives forth its annual harvests.

	Population, 1872.	*Gold and Silver Product*, 1872.
Colorado	50,000	3,001,751
Arizona	9,650	143,777
Nevada	45,000	25,548,811
Wyoming	9,118	750,000
Idaho	25,000	2,514,090
Montana	20,590	4,442,135
Utah	100,000	3,521,020
New Mexico	86,245	535,072

Regarding the importance of the project for a national system of irrigation, we cannot do better than quote from Gov. Elbert's address before the Denver convention: "As a matter of duty to its citizens, no government can afford to let so vast and splendid a portion of its domain lie waste. As a matter of finance, no government can afford to let the countless millions of material wealth which lie locked in the productive capabilities of such a domain sleep unsummoned. The constant increase of emigration from Europe, the regular growth of our native population, the steady expansion of our railway system, the quickened power and increased volume of all the forces of industrial organization seeking new and broader fields of conquest—all supplicate for the thorough and favorable consideration of the question."

Some of the public men of the country have examined into the methods and feasibility of irrigation for the great district of the New West. Roscoe Conkling, in a recent letter, after bringing out some important points on the subject, and stating his hearty concurrence with the views of the people of the territories in their move for a national system of irrigation, concludes as follows: "Water for the savannas of the two slopes of the Rocky mountains is one of the great problems of the age. Once solved, it changes an empire from a desert to a garden, and adds untold wealth to our country as suddenly as if by the magic of alchemy. Finding a way to water the Western plains, would be like the discovery of a new continent, and the Columbus who hits upon it will have a niche by the side of the sailor of Genoa."

SOMETHING TOWARDS MAKING BUILDINGS FIREPROOF.

THE term "fireproof" has a relative, not an absolute meaning. It is applied to structures that are rather non-inflammable than non-combustible, as the total exemption from the destructive power of fire can be claimed for no substance used in building. That, however, which does not flame in the ordinary circumstances of public fires, neither originates nor spreads fires in buildings, and, in a practical sense, as against fire destruction, may be pronounced non-ignitable. The question of cost in securing the highest ratio of fire-exemption in buildings retards the progress of such architectural precaution, and we manifestly have no system of fire-defensive architecture worthy of the name. Fireproof buildings, though exceedingly desirable, are always expensive, from the cost of iron girders and roof, arches, and extra walls, &c.; but buildings can be constructed about equally fireproof without any large addition to the cost.

We give, to this end, a plan for the improvement and safety of buildings, different from any before the public, though the "filling process" for floors alone has long been partially used in Europe, particularly in the city of Florence.

Let 3-inch joists be placed 15 inches between centres, and on the lower edge, for the whole length of each joist, screw firmly a cast-iron plate ⅜-inch thick and 4 inches wide, which will give ½-inch projection on each side of a joist. Let slabs of slate, or earthenware for common houses, be made ½-inch in thickness, and of width sufficient to just fill between the joists: the slabs should also overlap, by shoulders, at the joints. These pieces of slate, being laid on the projecting cast-iron supports, will form, when painted, a smooth, handsome, and incombustible ceiling, and the uniformity of appearance would be relieved by the projecting strips of iron. On this slate let pieces of slag from iron furnaces, broken into the size of nut coal, be filled between the joists to within ½-inch of the top of joists, and tightly rammed. Over this, and covering the top of the joists, spread one inch in thickness of mortar, and upon it lay a smooth floor of slate ¾-inch thick, and in slabs as large as convenient.

For partitions the ordinary studding could be used, commencing to nail laths upon each side of the uprights at the bottom, fastening them stronger than is customary; then continue to fill in the small pieces of slag close up to the ceiling, and when plastered the partition will be solid and incombustible, in the general sense of the term. Laths, studding, and joists, thus combined with filling, could not be fired without great effort, and would then burn but slowly. We give no special description of stairways, except to say that they can be lathed, filled, and plastered, as described for partitions: the sides and "rising-boards" could be replaced by thin slate, and the step-boards by slate or iron, as might be preferred.

If proper battlement walls and sheet-iron cornices were used, with slate or gravel roofs, sheathed underneath with roofing-slate, buildings entirely fireproof could be constructed at an advance of cost over the usual style, *small*, when the advantages of safety and lower insurance premiums are considered, and at much less cost than where iron joists and roof, and brick partitions are used.

No extensive conflagrations could ever occur with such buildings, or even if one-third of the houses of a town or city were so constructed; and it is doubtful whether one such building could be destroyed, if there was a single fire engine in the city. By the slow creeping of the fire, ample time, which is so important in such cases, would be gained for extinguishment. Additional improvements and security would arise from the fact that, by the system here shown, old, but well-built houses could be made completely fireproof, without change of form or interior arrangement. Not one of the least public advantages would be a diminution, instead of (what must necessarily be) an increasing cost of fire-extinguishment, and a feeling of confidence that such service, as organized and equipped, would be fully adequate for any possible emergency.

We are inclined to the belief that municipal government has more power to regulate the construction of buildings than it has yet ever exercised. The recent judicial decision, that the city had the right to compel the laying of improved pavements in certain localities, has a direct bearing on this important question. The municipal regulation of architecture, which, with us, assumes the form of building commissioners, whose duties and powers are quite limited, and their inspection often evaded, is, in European cities, much more minute and stringent, the responsibility more clearly defined, and builders are forced to some extra expense for the general good and safety.

SUPERHEATED STEAM AND ITS PUBLIC DISTRIBUTION FOR DOMESTIC AND INDUSTRIAL USES.

THERE are various considerations, of augmenting importance, which make it more desirable than ever that some more convenient and safer mode of heating dwellings and stores should be generally employed, with means in connection therewith to afford sufficient heat for all culinary purposes, and steam-power for mechanism—all distributed from central stations.

Several years ago, it was proposed that buildings should be heated by steam or hot air from central establishments, at a rental for the service, as in the case of gas and water. This, all know, it would be practical to arrange; but, we believe, no provision was made in the plan for a higher degree of heat than would be furnished by steam at a pressure of 80 to 100 pounds per square inch, and a temperature of 212° Fah. A modification or extension of this idea is not more impracticable or dangerous than the introduction of certain other improvements at first appeared to be, and, therefore, is not unworthy of attention; for invention may be stimulated to furnish the best plan for its accomplishment.

Undoubtedly, the safest modes of heating in use at present are either hot water circulating in pipes, or steam at a temperature of 10° to 20° Fah., distributed through pipes from a boiler placed in the basement of the building, or in a vault at the front or rear. Boilers with automatic dampers, doors, and safety-valves, and with return circulation of water, have been so constructed that very little attention is needed. The principal objection has been, first, the dislike and feeling of insecurity which many persons have towards a steam-boiler—even at very low pressure—in the cellar of a dwelling: some unlooked-for accident is feared which might prove very disastrous. But the same objection existed in regard to illuminating gas when first proposed, and it was violently opposed. In Paris, the learned and cultivated Charles Nodier declaimed earnestly against it, and predicted all kinds of evil from its introduction. With the present arrangement, a simple safeguard, satisfactory to the fears of the most timid, would be to place the boiler in a vault immediately adjoining the rear, but outside of the building.

If immunity from risk of fire and the great saving of personal inconvenience were duly considered, and plans adopted to make explosions impossible, or at least harmless, it would probably not be long before steam-heating would be used in all large and medium-sized houses, as it now is in hotels and large offices—especially if it could be obtained as easily as water or gas.

With the improvements invented within the past twenty years, it is practicable to convey steam to any reasonable distance (say for two blocks) without much loss or waste. This can be done by enclosing subterranean pipes in a proper manner; and, with the aid of steam-traps arranged at certain intervals, conducting the condensed water from all pipes back to the boiler, dry steam would be furnished and due economy observed. But, should a system so much to be desired for our cities be perfected, there would still be something needed to render it not only efficient to the housekeeper, but remunerative to the company furnishing the steam.

The question is, then, whether any means exist by which sufficient heat can be transmitted from a central station to be serviceable for all culinary purposes, as well as for heating. We believe this important object is at least well worthy of careful study, if not yet fully practical, and shall proceed, *inter alia*, to show in what manner it may be accomplished in the future.

It would require the use of two separate series of boilers and pipes, one of them furnishing steam at a pressure, say 20 pounds per square inch, for general heating and manufacturing purposes. This low pressure would greatly diminish the wear on pipes, joints, and valves, and by the use of engines with comparatively large diameter of cylinders, short stroke, and working at a high rate of speed, as much power could be obtained as would probably be needed. Besides comfort in the mode of heating, we can hardly over-estimate the safety and convenience this would afford, to those requiring moderate power, in thickly inhabited localities; but large factories, which are generally built in the suburbs, or isolated in some way, would without doubt continue the present arrangements.

There is another mode of conveying motion which would dispense with engines, saving their cost and the attendance of them to those renting power. A narrow vault, like the Holburn viaduct in London—which is 7 feet wide by 11½ feet in height, and properly ventilated—could be excavated under the centre of each main street to be supplied, and converging at the subterranean stations which will be hereafter described. This would permit the easy introduction of steam for power, besides all the required steam-pipes, and give superior facilities for examination and repairs.

The other series of pipes could distribute from the same centre, but from different boilers, *surcharged* or *superheated* steam (the terms are identical) at a suitable temperature, up to 800° Fah. This *force*—for in that state it could hardly be called steam or gas—traversing pipes sufficiently strong and properly protected, with coils enclosed in ranges and ovens, on arriving in houses, would give sufficient heat for all culinary purposes—even roasting, broiling, and frying, which cannot now be accomplished by the best steam-fixtures in use.

For the general reader, it may be well to premise, that ordinary steam at 212° Fah., contains so much water, in the form of finely-divided spray, as to cause, according to eminent scientists, a loss of power of 20 to 40 per cent. in the working of engines, through condensation in the cylinder. Such steam is susceptible of receiving, in addition to the large quantity of latent heat it holds, a still greater amount, if heat be applied to a coil of pipe of sufficient length, containing steam; and the superheated steam thus formed develops such power and properties as to make it appear like a new substance.*

As has been proved by experiments made by Chief Engineer Isherwood, U.S.N., and experiments made in the British naval vessels, and reported by John Bourne, C.E., 360° Fah. is the highest temperature at which superheated steam can be used in engines, without injury to them. Above that degree it ruins cylinder, piston, and springs; for, the iron at excessive temperature has its affinity for oxygen vastly increased; it therefore decomposes the steam, unites with the oxygen of the latter, and liberates hydrogen gas, while the iron becomes a spongy protoxide, much resembling graphite. The want of proper knowledge of this fact led many of the earlier experimenters into grave errors, and caused not a small amount of damage to machinery and disgust to the owners.

The question naturally arises: If an economy of at least 20 per cent. is shown—and we cannot trace a single trial of superheated steam among the many we have examined where at least that much gain was not conceded, and the average gain is nearly 25 per cent.—why has it not come into general use? It is much more used in Europe than in the United States, partly from scarcity of fuel, and partly because of more extensive experiments giving confidence. Doubtless the injury

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* If water is boiled under atmospheric pressure only, after it attains 212° Fah., a thermometer placed in it will rise no higher, and will also mark only 212° in the steam. If it required one hour to raise the temperature of a given quantity of water from 32° to 212°, it will take 5½ hours to convert all the water into steam; therefore, $212 - 32 = 180 \times 5\frac{1}{2} + 212 = 1202^\circ$ of heat of ordinary steam, of which 990° are latent, and 212° sensible. This varies slightly from Regnault, who made the total 1146° Fah.

Regnault demonstrated that the total heat of steam increased .305° Fah. for each degree added, and his formula for steam at 212° is: $H = (1113.4 - 32) + .305$, or $H = 1081.4 + .305$, making the total heat 1146°. The mean increase of volume from water to steam is now settled at 1700; that is, one cubic inch of water in steam at atmospheric pressure, will about fill one cubic foot. According to the law of Marriotte and Boyle, that "the elastic force of gas and steam is always inversely as the space into which it is compressed," the following table will show the *relative* pressure at some of the higher temperatures:—

212°...............	15 lbs. to square inch.	290°..............	60 lbs. to square inch.
250°...............	30 lbs. to square inch.	372°..............	180 lbs. to square inch.
275°...............	45 lbs. to square inch.	432°..............	300 lbs. to square inch.

At this ratio of increase, at 800° Fah. the pressure would be about 8,000 pounds per square inch. Steam at 212° can, by continued generation in a tight boiler, be made to exert a pressure of 60, 80, 100, or 120 pounds, or more, per square inch, according to the strength of the boiler, with only trifling increase of temperature over 212°; but, if the pressure of steam at 212° be 15 pounds per square inch (atmospheric pressure), at 432° it would be, relatively, 300 pounds to the square inch, and so on.

to engines at first, the expense and wear and tear of pipes, which is great, together with fear of injury to cylinders, by the temperature accidentally getting too high, are in part the reasons why it has not been more extensively adopted;* but the disadvantages in engines and vessels, except corrosion, would not affect the plan here advocated.

We can now, with the assistance of the foregoing data, better judge of the capabilities of superheated steam to perform domestic duty, in connection with ordinary steam for heating and power; but it is evident that some plan must be devised to prevent undue corrosion of iron pipes, or some substitute for the iron be found, before the use of surcharged steam can be made satisfactory. In all probability, copper pipes of proper strength would overcome the difficulty, and, if not placed in direct contact with flame, would support the required temperature.†

The following suggestions, which, of course, in practice might need modification, are submitted as the basis of a plan, by which, even in the most crowded cities, the desirable domestic comforts we have indicated, and the distribution of power, may be realized. As the arrangement should be made with the greatest economy of working, even though at additional expense on starting, all the water of condensation must be returned to the boilers. Condensation, as regards superheated steam, even more than in ordinary steam, and the corrosion of pipes already mentioned, will be found to be the two main difficulties in this plan; but it is only the latter, together with the heavy pressure on pipes and valves from steam at 800°, which is serious. In using surcharged steam in engines, so rapid is the tendency to cool on entering the cylinder, that the most careful jacketing is necessary to insure success.

It is true, that as the surcharged steam would, in the mode of heating ranges here proposed, traverse only small pipes continuously—and these carefully protected until reaching their destination—less difficulty would arise from condensation; but still, at the first, it will be found to be formidable. To receive back properly the water of condensation, the boilers should be so located that their upper portion be 15 feet below the surface of the street.

As drainage might thus be rendered difficult in a city which has not in some portions much elevation above tide-water, it would be advisable to use *distilled* water in the boilers for heating purposes only. They would then rarely be troubled with scale, and there would be a complete circulation, as with the blood to and from the heart—the steam representing the arterial, and the condensed water the veinous blood. This system of circulation—but using ordinary water—is in successful operation in some boilers in Philadelphia, and is productive of great economy.

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* The superheating apparatus is, of itself, objectionable, from its cost and weight, and especially on account of the constant attention it requires from the engineer. It is always liable to overheating when the engine is temporarily stopped, and it suffers a rapid deterioration of its tubes from internal corrosion.—*Isherwood, C.E. Experimental Researches, A.D.*, 1863; *Vol.* 1, *p.* 3.

† The melting-point of copper is placed by Daniell at 1996° Fah. By actual experiment, the *diminution* of strength of *copper* boiler-plates, at a temperature of 1332° Fah., was found to be 1.0000. The diminution of strength of *iron* plates, at 1317° Fah., =0.7001.—*Templeton on Steam, &c.*, 1872; *p.* 142.

"Double extra" wrought-iron pipes, lap-welded, are now made to stand 2,000 pounds to the square inch, and could be made to stand 2,500 pounds. Hydraulic pipe with bore ¼ inch, and diameter 1⅛ to 1¼ inch, will bear any pressure that can be put inside. It therefore seems very probable that by making copper pipes for superheated steam one-third thicker than the "double extra" iron pipes, as now made, they would stand the heavy pressure, and without corrosion. At any rate, copper pipe made like iron hydraulic pipe now is, would undoubtedly stand 8,000 pounds pressure per square inch. The greatest difficulty would be in valves to control it.

The stations for boilers could be located in large vaults, excavated under the intersection of two main streets, thus allowing easy divergence of pipes to four blocks from one reservoir, and the draught required by the furnaces could be obtained by ornamental towers at the corner buildings, or by long flues under houses, to chimneys in their rear. By the use of two sets of boilers for each service, should one need repairs, the water could be transferred to another, and no accident need stop supplies of steam. By the use of the best iron, and most improved safety valves and gauges, explosions might be wholly unknown, especially as the pressure need never exceed thirty pounds to the square inch.

The heat passing through the uptake of the chimney would not be sufficient to effect the surcharging of steam to 800° Fah., with some addition for waste. In the experiments already mentioned, the average heat in the uptake was about 650°, which developed heat in the steam in the coils to 360° Fah. An additional furnace would therefore be necessary outside of the stack, unless the interior flues and furnace fires could be utilized for such service, which would neither be safe for the pipes, nor convenient of access for repairs.

The most important point, after proper location, and overcoming the corrosion of pipes and providing for the heavy pressure, would be the placing of the supply and return pipes in such position as to secure perfect drainage and circulation, together with protection from loss of heat, and, for the superheated steam-pipes, convenience of access. If both series were placed in the earth it might be quite near the surface—as, being always heated, and also protected by covering, the action of frost need not be feared. In such case the surcharged lines should be laid in square boxes, or, so to speak, channels of firebrick, having an interior chamber holding the pipes, surrounded by the heated air, and an exterior space filled with charcoal.

The ordinary steam and all return pipes could be covered with hair felting and cement, and laid in a thick, rough, wooden trough. Such precautions would prevent any serious loss of heat, though some waste must naturally be expected. There is another plan, which, from convenience of access, might be considered advantageous. Let the present stone curbs of the sidewalk be replaced by hollow cast-iron curbs, say one-half inch in thickness, except on the front, where they should be one inch thick. They should be fifteen inches wide at the top, having tight covers, secured by sunken screws; and there should be a tight, interior chamber, large enough to accommodate the pipes, and leave a space outside and around said chamber, to be packed with charcoal or cow's hair.

Care should be taken that any brick flues, or covering for pipe, be made with hydraulic cement, to prevent crumbling in case of leakage, and, wherever possible, some loss of space should be permitted, rather than contract the air-space around steam-pipes.*

Let it not be considered that these propositions are impracticable or fanciful, because all the details are not yet worked out. They present less difficulties to the skilled mechanic of this age, than the distribution of water and gas in their first introduction through pipes to each house in cities; and there are causes operating more forcibly every year, to render the adoption of some such plan necessary. Among these we name the question of domestic help or service, which is becoming continually more difficult. The arrangement here advocated would dispense with at least one servant for every *large* family; while in many others, previously employing culinary help, the mistress being entirely relieved from any care of fires, and much dirt and dust, would prefer preparing the food to having the annoyance and expense of the said service.

The other reasons are a question of economy, and the gradual disappearance, in time, of forests and coal, which latter difficulty, though slow of arrival perhaps, will be sure to come, and possibly before the substitution of another fuel. Of petroleum little can be predicted, and, in the future, the demand for coal must be necessarily far more enormous than at present, as the activity of manufactures and arts, and the wide diffusion of the comforts and luxuries of life, will more than keep pace with growth of population.

The increased ratio of safety from loss by fire, whether single or in conflagrations, would be very great. No open fires would exist; steam-pipes being thoroughly protected by brick flues, made with hydraulic cement, could not be dangerous; and convenient ranges and boilers for baths would be heated by the surcharged steam only when actually needed; thereby making it more practicable than at present for the rates of insurance to sustain the companies.

USES AND VALUE OF THE BAMBOO.

IT is rather remarkable that a people so quick-sighted for their interest, so industrious, and inventive as the American nation, should not, as yet, have adopted for numerous purposes the wonderful bamboo reed, ***Bambusa Arundinacea***, which is produced in Asia, Polynesia, Brazil, and the West Indies, but here used for scarcely any purpose but fishing-rods and pipe-stems. This arborescent grass is more important to China, Japan, India, Pegu, Siam, and all the eastern islands, than cotton and wool are to the United States; and the gold mines of California, compared with the advantages the bamboo yields to so large a portion of the world, sink into insignificance.

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* Steam exhausting into a chimney, or impinging against ordinary mortar and brick-work, is ruinous to it. The large stack of a steam flouring mill in Fairfield, Iowa, fell a few years ago and demolished the whole building. In this case the exhaust from the engine was allowed to enter the uptake, near the base, without any pipe to conduct it to the top.—*Architectural Review, August*, 1869.

On the other hand, cases are on record of water cisterns built with cement, into and over the contents of which, steam was freely exhausted, without apparent injury to the bricks or cement.

Scarcely anything is to be found in China and Japan, on land or water, into the composition of which this ubiquitous reed does not in some way enter, if indeed it be not the sole constituent. Bridges, boats, masts, rigging, ropes, sails, houses entire, partitions, screens, bedsteads, bedding, mats, nets, fans, baskets, hats, chairs, tables, book-cases, carts, yokes, harness, pumps, water-wheels, troughs, water-pipes and spouts, agricultural and other machinery, candle-wicks, paper, musical instruments, astronomical tubes, shields, pike and spear handles, pipe-stems, succulent food and comfits from the young shoots, and even a stimulating liquor and a medicine from the same.* Well, we must stop to take breath—the view is astonishing! To the above uses it must be added that it is much slower to burn and harder to kindle than wood—resists acids much better, and, by fusion with alkalies, is said to form a durable and transparent glass; the latter probably on account of its exterior coat being mostly silex. Exquisite carvings, inlaid with gold and silver, and far more elegant than ivory work, are also produced from the hard stems, and even the roots are fashioned into pipes and articles of great beauty.

Now, supposing that without expecting it to be applied to one tithe of the uses to which the above nations apply it, we should commence employing it here for such articles as cheap cottage furniture sets, field and garden fences, posts, gutters, spouts, and ornaments for porches, pumps, wall and wrapping paper, supports of awnings, and irrigating and drain-tubes, what an immense source of wealth would be added to the nation without injury to any trade or art. The great advantage would be that various indispensable articles could be so cheapened, and the quantity indefinitely multiplied, that many of the poorer classes could have comforts which they are now unable to obtain, and, if the richer portion of the community did not admire them, the present forms could always be had; but so much beauty can be combined with the use of this reed, even in architecture, that many wealthy persons would be found preferring its use if only for the advantage of extreme lightness. This quality, together with strength and durability when exposed to the weather, as in fences, &c., is probably greater than such advantages in any other vegetable production, and doubtless, if once well introduced, adaptations would be found for it, exceeding those discovered in its native climes.

We admit the great ingenuity of the Chinese and Japanese, and their economy in materials, &c., is a model to the world; but our improved implements of work and our culture would give us a certain superiority they have not attained. For instance, in its use as a material for paper, for which the demand is so enormous and increasing, our uses of it would be different and more extensive than theirs. In furniture a great advantage would be found from no paint being required, and varnish would be used merely as an ornament. If used for fences, posts of porches, and trellises, it would, most probably, where above the ground, last four times as long as those now in use—thus saving in a short time many millions of dollars. If used for awning-frames, the weight would be about one-fifteenth that of iron, and cheapness nearly in same proportion; for pumps, boring would be unnecessary; and even in the trivial matter of *broomsticks*, from their increased lightness, a vast amount of muscular force would be saved. It is not at all improbable that entire carriage bodies would be formed of it, and its lightness and elasticity fully appreciated in numerous uses.

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* Two principal reasons for this general adaptation are—first, the natural and regular cylindrical shape; and, second, that by slitting and soaking the reed in warm water, it can be pressed flat in boards from 4 to 24 inches wide, which form it retains on drying, and has on one side already a glazed silicious coating.

These ideas, advanced more to provoke thought than to gratify it, will cause any considerate and inventive mind to see various advantages, if not actual improvements, that would arise from the adoption of this most useful plant. There is really no reason that we should hesitate to employ it on account of the people from whom its manifold uses were learned. It is true wisdom to use anything which is an improvement, no matter whence derived. Europe was very willing to borrow from the Chinese the manufacture of silk, paper-money, movable types, the mariner's compass, and gunpowder, and we need not now be ashamed to learn from them the uses of bamboo.

Anyone who will look at a terrestrial globe will perceive that many parts of the United States—indeed the whole of that portion south of 35° of latitude—have a similar locality for the growth of this plant as certain portions of China. A strictly tropical climate is not necessary for it, as one rather milder has in some instances proved more suitable; in proof of which we can advance the fact that in the island of Bourbon one splendid variety—the *Nastus*—flourishes best upon the sides of the mountains, at an elevation of 3,700 to 5,000 feet. M. Hubert, a distinguished agriculturist of that colony, who endeavored to embellish his grounds in the lowlands with its graceful and majestic forms, was not successful in the effort. Other varieties, however, grow all over the adjacent islands of Mauritius and Madagascar, and on the island of Java, at an elevation of 1,000 to 1,500 feet.

In an æsthetic point of view this plant, as an ornament, yields to none in the world. Bernadin de Saint Pierre, in his charming story of Paul and Virginia, was the first to impress upon the attention of Europeans the beauty of the bamboo in the isle of France, especially where massed in long, picturesque avenues. Marco Polo, in his travels, (vol. ii,) mentions bamboo canes 30 to 60 feet in length, and 4 to 6 inches in diameter at the base, though they grow as large as 8 inches in diameter; and M. de Guignes and M. Van Braam speak of the admirable light and strong cordage manufactured from it. The old Venetian also describes a pavilion of the grand khan of Tartary, the roof of which was made of bamboo, about 4 inches in diameter, richly gilt and varnished.

In regions not too hot, the borders of rivers and marshes are suitable for its growth, as well as dry land and the sides of mountains, at a moderate elevation in tropical regions. In this country, not only is there in a part of it the exact climate required, but a variation of it in others, by mountain-valleys and table-lands, and islands in great lakes, which latter situations have proved the best for vineyards, and would doubtless suit equally well for the bamboo. We could also profit by the experience of the Chinese and Japanese, for they have voluminous treatises devoted solely to the cultivation of this reed, giving rules for planting, transplanting, and watering it, the proper soil and temperature, the various sizes and kinds, with the mode of macerating for paper, and extracting food, liquor, confectionery, and medicine, from the tender portions. All these works could easily be translated.

The color of the stems is usually yellow, but the Chinese possess secret methods of cultivation, which will change it to chestnut or to black, just as they also have the means—we believe as yet unknown in this country—of producing perfect fruit-bearing, dwarf oak, chestnut, and apple trees. The black bamboo is cultivated in the gardens of the rich in China like any other rare plant, and the emperor has an officer connected with his palace whose sole duty is to attend to the bamboo in the imperial gardens. The joints of the ordinary kinds are usually from 4 to 6 inches apart, but in some highly prized varieties the distance is from 4 to 5 feet.

It generally requires a sandy soil, where the roots will easily penetrate, and although it will grow well near water-courses, the roots must not be allowed to reach the water, or the plant will die. Propagation is always by suckers, for it it rarely blossoms, and scarcely ever perfects its seeds. Planting is generally done in the spring and autumn, and requires but little care, and winter is the best time to cut, because the wood is then hardest.

Loudon, in his Botanical Dictionary, gives fifty varieties of the *Arundo bambos* of Linnæus alone, which grows to the height of from 50 to 80 feet the *first* year, and whose appearance is very imposing and graceful, as it spreads far up like a great sheaf, and the tender shoots and buds hang above like the spray and drops of a fountain. The second year the wood is more perfected in hardness and elasticity, when it is cut for use, and the production per acre is enormous. The plantations are, however, often left to harden until the fourth or fifth year. M. Kunth, the celebrated naturalist, divides the bamboo into five classes—the *Arundo bambos*, *Beesha*, *Chusquea*, *Gradua*, and *Nastus*. The first is the most widely diffused and useful, and the latter the most beautiful, being chiefly found in the island of Bourbon, lying on the east of Madagascar.

The following description by an enthusiastic naturalist is very graphic and illustrative: "Few vegetable productions present an appearance so majestic, and at the same time so light and airy, as the *Bambusa Arundinacea*. A tuft of stems first springs from the root, rising to a height of 25 to 60 feet, after dividing in all directions and developing into an immense sheaf. These stems, cylindrical, polished, and gleaming with a beautiful yellow color, are interspersed at intervals with knots, from whence, to within three feet of the ground, grow other stems—becoming smaller and smaller towards the top, and bearing multitudes of ribbon-like leaves of the most beautiful green color, and mobile as those of the aspen. They have all the lovely shades of color and the gracefulness of vast aerial ostrich plumes."

Probably one of the principal reasons of the extensive use of the bamboo in China and Japan is the immense condensed population, especially in the former nation, which makes the struggle for existence severe, and the necessity for economy great. But it is evident that the propriety of the use has so much to recommend it there, that all classes adopt it, even the most wealthy.

In our own country we are already beginning to feel, in higher prices, the scarcity of oak, ash, hickory, maple, and walnut woods—the latter now so fashionable for the interior finish of houses. Unless much attention is paid in the future to the planting and growth of these more valuable kinds of timber, we shall, not many years hence, need to import largely the finer woods at a still advanced price. Could some of the demand for these be lessened, by substituting the bamboo in the manufacture of many articles of the cheaper description, the advantage would be felt in all departments of the arts.

STATE OF INDIANA,
OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, December 4, 1873.

Editor American Exchange and Review:—

DEAR SIR—I send you herewith a table that may be of some service, showing some of our products for 1873. The statistics are made up from returns to county assessors on the first day of April, and show the products of the year ending that date. It is but fair to say that, as this is the first year of the law, we do not regard the returns as in every respect reliable. These are the returns, however, as made to this office.

Very respectfully,

J. C. BURNETT,
Deputy Auditor of State.

INDIANA.

Statistics, April 1, 1873.

No. of horses.	*No. of mules.*	*No. of cattle.*	*No. of sheep.*	*No. of hogs.*
514,438	54,307	1,211,246	1,235,874	2,999,139
Acres of wheat.	*Acres of corn.*	*Acres of oats.*	*Acres of meadow.*	*Acres in cultivation.*
1,902,599	2,627,980	624,795	985,529	6,162,157
Bushels of wheat.	*Bushels of corn.*	*Bushels of rye.*	*Bushels of oats.*	*Bushels of pototoes.*
22,149,527	81,185,485	333,153	11,434,628	3,412,159
Bushels of barley.	*Tons of hay.*	*Pounds of wool.*	*Pounds of Tobacco.*	*Acres of Pasture.*
522,943	825,477	2,228,437	12,377,182	4,511,775

MINING AND METALLURGY.

THE statistical report of the secretary of the Iron and Steel Association, presented to that body at its meeting in Philadelphia, November 20, 1873, contains information of much interest in regard to the present and prospective condition of the iron industries of the country. We give herewith an abstract of such portions of this valuable document as bear directly upon this topic.

Reference is made, at the outset, to the flourishing condition of the iron trade in all parts of the country at the close of the year 1872, as indicated by the largely increased demand and the greatly stimulated production—as evidenced by the erection in the United States of forty new furnaces and the projection of others. Towards the close of the year, however, the high prices which had prevailed for iron in the United States gradually declined, and this decline has steadily continued throughout the year 1873, until at present the prices of iron in some branches of the trade have reached a point far below the cost of production. The causes of this decline, the report further states to have been the natural tendency of high prices to restrict consumption, and the forced subsidence at the close of 1872 of the fever for building western railroads; in consequence of which the demand for rails and other railway material fell off greatly, as did also the consumption of iron in other branches of the trade, usually requiring large supplies. The financial panic following upon the heels of this unfortunate state of affairs, completed the prostration of the iron industries.

At the beginning of the month of November, fully *one-third* of the iron furnaces in the country were out of blast, and the activity of the bar and rail mills correspondingly lessened; and the indications are that, at the time of this writing, no less than one-half of all the furnaces are out of blast. The mining of ore has of course shared in the general prostration of the iron trade.

Production of Pig Iron.—The production of pig iron in this country for 1872 was 2,830,700 net tons. The ascertained production during the first six months of 1873 was 1,393,075 net tons, and the estimated production for the whole year is 2,695,434 net tons. The estimated falling off from the production of 1872 is 134,636 net tons. It is regarded as most probable that the production for 1873 would have exceeded 3,000,000 tons, had the financial crisis not interfered. The estimated annual capacity of all the furnaces in the United States is 4,371,277 net tons. The total number of furnaces in the country, exclusive of those abandoned and projected, is stated to be 636. The total number of new furnaces finished and put in blast in 1872 was 41; finished and put in blast in 1873, 42—making a total for two years of 83 new furnaces—by which the furnace capacity of the country has been increased fully one-fourth. As in former years, Pennsylvania still retains her position of supremacy in iron production, the furnaces of the State producing nearly one-half of the total yield of the whole country.

Rails.—The American make of rails during the year 1873 is estimated at about 850,000 net tons, of which 120,000 tons will be Bessemer rails. This estimate shows a falling off from the figures of the preceding year of nearly 100,000 tons.

Rolled and Forged Iron.—The following summary gives a comparison of the production of the merchant-bar mills, plate mills, and other rolling mills (exclusive of rail mills), for the years 1872 and 1873, in tons of 2,000 pounds:—

	1872.	1873.
Merchant bar and rod	500,000 tons.	400,000 tons.
Sheet and plate	200,000 "	250,000 "
Hoop	30,000 "	30,000 "
Nails and spikes	175,000 "	200,000 "
Axles, &c.	95,000 "	100,000 "
Total	1,000,000 tons.	980,000 tons.
Add iron and steel rails	941,992 "	850,000 "
Total rolled iron	1,941,992 tons.	1,830,000 tons.

Production of Steel.—There were produced in the United States during the year 1872 about 32,000 net tons of cast steel, and in 1873 there will be produced about 28,000 tons. The production of Bessemer steel is steadily on the increase: that of 1871 was 45,000 tons; of 1872, 110,500 tons; and in 1873 it is estimated that at least 140,000 tons will be produced. The Siemens-Martin process has received but little attention in this country. In 1872, the amount of steel produced by that process aggregated but a few thousand tons. Bessemer works for the manufacture of steel and the rolling of rails are at present in operation in the following places: Troy, N.Y.; Johnstown, Harrisburg, and Bethlehem, Pa.; Newburg, Ohio; Chicago (two establishments) and Joliet, Ill. The Pennsylvania steel works, at Harrisburg, are now building a new plant, to be completed in 1874, which will double their present capacity, while the Edgar Thomson steel works, near Pittsburgh, Pa., are expected to be completed in 1874. The total annual capacity of the eight Bessemer establishments now in operation is about 170,000 tons of rails—a sum which the new works now in course of erection will swell to 220,000 tons.

Summary of Iron and Steel Production.—The accompanying tabular statement is a summary, in net tons, of the ascertained and estimated production of iron and steel in the United States in 1872 and 1873:—

	1872.	1873.
Iron and steel rails	941,992 tons.	850,000 tons.
Other rolled and hammered iron	1,000,000 "	980,000 "
Forges and bloomeries	58,000 "	50,000 "
Cast steel	32,000 "	28,000 "
Bessemer steel	110,500 "	140,000 "
Siemens-Martin steel	3,000 "	3,500 "
Pig iron	2,830,070 "	2,695,434 "

——THE system of substituting machinery, in the mining of coal, for manual labor, which has for some years attracted extended notice, has received, in England, a much larger share of attention than in this country, where, from the abundance of the coal itself, and its comparative proximity to the surface, the question of economic extraction has not yet become so imperative as it has abroad. One American instance, however, the Coal Brook mines of Brazil, Ind., to which we have referred and in which the introduction of machine cutters has been attended with most satisfactory effect, warrants the conclusion that in many portions of the bituminous coal regions of our country they would be attended with equally favorable results.

There are many difficulties and incidental qualifying circumstances which enter into the solution of this problem, making it extremely hazardous to lay down general assertions to apply to all cases; and the best results from the application of machine work will only be attained after extensive experiments with various systems, and under the varied conditions of practice. This, it is evident, can only be accomplished at great cost to the experimenters, but is the only practical method of solving the problem. Through precisely this stage of its solution the problem is now passing in England, where experimental trials with a large number of machine coal-cutters have for several years past been carried on in some of the largest mines of the country. The result of these trials seems to be that, though the practicability and the superior advantage of mechanical coal-cutting over the old system of hewing by hand have been fully demonstrated, no one system of application has proved itself the best adapted under all circumstances, and, additionally, the drawback must yet be overcome of the practical difficulty of carrying the compressed air—which seems to be the only motive power suitable for the purpose—through the great lengths of pipe which would be required for an extensive mine without serious loss of power. Some of the statistics of the duty of these English machines will be of interest to many readers.

The Hetton Coal Company employs several of the machines of Wm. Baird & Co., and known as the Gartsherrie machine. Up to the present time the greatest quantity of coal cut at Hetton by one of these machines was 175 feet (about 67 tons) in a shift of nine hours. This result was attained only a short time since, and, with a good face to work upon, it is believed that it could not only be maintained, but even considerably increased. At the Espilside colliery, Gartsherrie, a machine of the same kind recently cut 377 feet (equal to 90 tons) in nine hours; another machine cut 350 feet, and another 200 feet in the same length of time, thus showing that at the mine first named the minimum duty of the machine has not yet been attained. The usual output of a hewer in the same seam that the Gartsherrie machine is applied to at Hetton is only 2½ tons per shift; so that if the average work of the machine were maintained at even 65 tons per shift, it would in that time accomplish the labor of 25 men. The Elemore pit is now being divided into sections, with a view of applying these machines on a larger and more complete scale. Each section will measure 60 yards by 20, and it is intended that each machine shall go across a face of 120 yards in length in twelve hours. By working four machines on this plan, it is calculated that a produce of 400 tons of coal per day could easily be obtained. This output would be equivalent to the labor of 150 men; and as it requires only three men, or a skilled mechanic and two lads, to work each machine, there would be thus a saving of the labor of 140 men in this colliery alone. This is no exaggerated estimate of the actual capabilities of the machine in a good seam, but it must not be assumed that equally good results could be obtained in every colliery.

There are some circumstances in which coal-cutting machines are entirely unsuitable; nor is it to be assumed that the introduction of coal-cutting machinery will greatly reduce the number of men employed in the mines. It will of course lighten, very materially, the labor of the collier; but its effect will be rather to increase the output of coal, than to supersede the services of the miners. At the Elemore pit it is necessary to employ fourteen men after each machine, to take the coal down, while another batch of colliers is required to hew all the narrow places and remove all angles, in order that the machine may have a full length of face to work upon. Men are also required to remove the double row of chucks along the face—chucks being blocks of wood, 20 inches long and 4 to 6 inches thick, used to suport the roof while the machine is "boring."

The example we have selected is only one of a large number of experiments which have been and are still being conducted in many of the largest collieries in England—a circumstance which indicates that, in spite of the disinclination of masters to leave the beaten tracks, and the risk and expense attendant upon the introduction of a new system not thoroughly tested as to its adaptability to their special cases, the substitution of machine-labor for hand-labor in the mines is slowly, but surely, making its way to general adoption.

——THE announcement is made of the discovery of an extensive coal field at St. George's bay, Newfoundland. It has been ascertained that several workable seams of superior quality exist there, the extent of which can only be determined by boring. Much of it appears to be cannel coal of a description much sought for in the manufacture of coal gas. This is, however, not the only coal region of Newfoundland. On the north-eastern shore of Grand lake are found precisely similar beds to those forming the south side of St. George's bay. Here the existence of a three-foot seam is reported, and the opinion is expressed by eminent judges that coal may be found over the whole or a greater part of this region. It is likewise probable that large deposits of magnetic iron ore will be shortly brought to light in this portion of the territory.

——Two nickel furnaces are now in course of erection in Madison county, Missouri. More than half a million dollars' worth of nickel has been exported from this region within the past three years; and the prosperous state of the industry of mining and smelting this metal is best indicated by the demand for an extension of facilities for its production, as shown by the erection of new furnaces.

——We hear but little of Illinois as a coal-producing State. It is strongly probable, however, that in this direction a future of much importance awaits her. In his work on The Coal Regions of America, Mr. MacFarlane speaks as follows of the coal-veins of Illinois: "The valuable features of the Illinois coal are, that there is plenty of it—that it is widely distributed over the State, and accessible; for, although it is necessary to mine by means of shafts in almost all cases, yet the coal is reached at a reasonable depth from the surface; its mining is done without unusual expense; the great number of railroads in all parts of this prairie State, with good, level grades, and without curves, furnish an abundance of cheap transportation; and, poor as the coal is, there is a large market for it, for want of a better. * * * Large quantities of Pennsylvania and Ohio coals are shipped from Chicago by rail, in all directions, as far west as Omaha, and south into the interior of Illinois. In localities too remote to obtain these, their own coal is extensively mined, and used for domestic purposes. More care in mining and cleaning would very much improve the quality of Illinois coal. It must be remembered, however, that probably the best coal of Illinois may not yet have been developed. The very valuable iron-smelting Big Muddy coal of Jackson county, in the southern part of the State, as well as some of a fair quality in other localities, gives us ground for hope of yet finding coal of a still better quality than much of that which is now mined. Certainly, a large amount of coal lately developed in west Indiana is of a much better quality than the coal of Illinois generally; and as we have no reports, as yet, of thorough explorations of the counties in the central and eastern parts of the State, in the vicinity of where the valuable seams of coal on the Indiana side have been discovered, we have reason to expect an extension of them into the eastern part of Illinois. * * * The wide distribution and vast extent of the Illinois coal field are truly wonderful. Her coal fields are as inexhaustible as the soil of her fertile prairies.

"The United States census of 1870 reports the production of coal in Illinois at 2,629,563 tons. To those accustomed to the large production of the Eastern mines near our shipboard or large cities, these figures may appear small, but it should be considered that this is but the infancy of the coal business in the West. Many of the mines have been opened but a short time; the country is quite new and thinly settled; some of the localities are far in the interior, remote from large towns; and many of the particulars which have been mentioned here are given more as indicating what we may expect hereafter, than for their present importance."

——Some notes published in the current number of the Journal of the Meteorological Society, on the connection between atmospheric pressure and colliery explosions, seem to indicate that the escape of fire-damp in the mines is frequently the result of peculiar meteorological conditions. The authors of the notes in question are Mr. R. H. Scott, F.R.S., of the meteorological office, and Mr. W. Galloway, inspector of mines. From the statements therein contained, it appears that 207 colliery explosions occurred during the year 1871. A careful analysis of these occurrences induced the authors to conclude that 55 per cent. of the explosions were connected with the low state of the barometer, and 19 per cent. were ascribable to changes of temperature, while the remaining 26 per cent. was unexplained by any of these meteorological causes. The paper contains some valuable hints on the method of making and recording observations with the barometer and thermometer, and will be of service to all who have the responsibility of the lives of others under their care.

——It is announced that underground connection between the east and west drifts of the great Sutro tunnel (Nevada) has at length been established. The engineering problem involved in the work was one demanding great skill and judgment on the part of those in charge. It was to run a drift from the bottom of a shaft south to the centre line of the tunnel, and then east along that line to meet a drift coming west from the tunnel mouth, 4,885 feet distant. The engineer in charge, Mr. Schussler, is to be congratulated upon the precision with which this difficult responsibility was met. We are informed that the variation in grade between the headings where connection was established was but half an inch, and the horizontal variation from centre line but seven-eighths of an inch. The work upon the tunnel, it is stated, will be vigorously prosecuted during the winter, the necessary capital for supplies and labor having been obtained.

——The name of Mr. E. F. Loiseau has occasionally been mentioned in this Review, in connection with a process for utilizing waste or slack coal, by employing, as a binding or cementing material, about five per cent. of ordinary yellow clay, and subsequently treating the lumps formed under pressure, to a bath of rosin dissolved in benzine, thus rendering the product waterproof. This process has received considerable attention from the various scientific societies and the technical press throughout the country, and the criticisms passed upon it have been, with a few exceptions, very favorable. This notice of the invention is called forth by the fact that Mr. Loiseau has recently much improved the machinery demanded by his process, and upon which much of the commercial value of this class of inventions must depend. At the recent fair of the American Institute, in New York, a complete working model of the machine was exhibited in operation, and attracted much notice. The operation of the process is entirely automatic, the crude materials being fed into one end of the apparatus and emerging from the other, finished and ready for transportation. No labor is required, nor does the machinery need any attention, except what is necessary to replenish the supply and remove the completed product. The lumps are made egg-shaped; this form having been adopted as the most practical, inasmuch as it permits of the largest interstices, and hence a freer passage of air between them. The lumps are thoroughly dried by passing a number of times through a long, hot air-oven, carried upon endless belts of wire-cloth. The waterproofing material does not penetrate to any considerable depth within the lumps, and they are therefore not saturated with the resinous material, which simply forms a light varnish over their surface, making them impervious to moisture, and enabling them to be handled without the annoyance of dust and dirt. The experimental trials conducted some time ago, to test the heating power of the product thus manufactured, indicated a very fair rate of such power, and considerable cohesion in the furnace. These qualities were fully tested at the exhibition, where the fuel was placed for trial under the boilers there in use, with very favorable results. As to the very important item of cost, the inventor states that it can be supplied for about one dollar per ton. It remains to be seen whether this assertion will be verified, for upon this item the practical success of the process depends.

We cannot look with indifference upon any endeavor which is made to utilize waste materials, since such utilization is directly adding to the wealth of the community. Nor can we close this brief notice without offering our tribute of praise to the energy and perseverance of Mr. Loiseau, who has labored upon this subject for years, and who deserves to reap a rich reward.

——The accompanying table represents the location and some particulars concerning some of the more important tunnels for mining purposes in the United States and abroad:—

	LENGTH.		DEPTH.	
Tunnel and Location.	*Miles.*	*Feet.*	*Feet.*	*Notes.*
Meissen, Freiberg, Germany	24.	126,720	....	....
Ernst August, Austria	13.60	72,000	1,200	June, 1864, 13 years' work.
George, Clausthal, Austria	10.80	57,000	900	Finished in 1799.
Joseph II, Schemnitz, Austria	9.10	48,000	....	Drain tunnel.
Rotheschœnberger, Freiberg, Ger.	8.	42,240	....	....
Sutro, (Comstock,) Nevada, U.S.	4.	21,178	2,000	4 shafts, 5,000 feet done.
Bear River, Cal., (to N. fork Am. R.,)	2.40	12,540	....	3 shafts.
San Carlos (prospected), Durango, Mex.	.50	2,640	2,500	(San Dimas mines.)

——In reference to the new Bacon Reversible Winding Engine, the Engineering and Mining Journal says: E. C. Bacon, at the Speedwell iron works, New York, has lately produced a machine which is specially designed for mine work. In general arrangement it follows the plan of Mr. Bacon's other hoists, but is made unusually strong, and is intended to run at 200 to 500 revolutions per minute. It is double-acting, has two steam cylinders, the piston-rods of which work in two flat trunks. This arrangement permits the use of direct gearing to the drum without sacrificing the compactness of the whole. For wire rope the drum is made large, and its length can be suited to the requirements of the mine. Three sizes are made, viz., 15, 28, and 45 horse-power. During the last four years Mr. Bacon has designed more than 20 different styles of hoisting engines. Those patterns which are intended for blast furnaces and mines are reported to be excellent in use.

INSURANCE.

NATIONAL board fire underwriters have now before them, for consideration and decision, the subject of co-insurance, or the association of company and policyholder in carrying the risk. The general topic takes the form of three optional propositions, all submitted by the board to the judgment of the companies, viz.: 1. That, whenever policies on manufacturing establishments contain an average or co-insurance clause, a deduction of 20 per cent. may be made from the standard rate. 2. That, when a manufacturer shall declare his willingness to insure not more than three-fourths of the actual cash value of his buildings and machinery and stock, and shall accept the form of policy required, with insertion of the co-insurance clause, a reduction of 20 per cent. be made in rate. 3. That, when a manufacturer shall accept the form of policy required, with insertion of co-insurance clause, a reduction of 10 per cent. shall be made in rate.

While, in doctrine, there is nothing novel in the proposals thus advanced, the election from them, yet involves the question of a practical reconstruction of American fire insurance as practiced. As a rule, the American policyholder has simply insured to receive indemnity in case of loss—that is, to free himself from all feeling and fact of responsibility, all sense of contingency, all apprehension of danger, all care, in respect to fire. Practically, he transfers to the underwriter the exercise of all the precaution which otherwise would fall upon himself. This great deliverance—this lifting of a huge burden—has been done by the underwriter, with more or less success, in the past; but slowly and reluctantly the confession begins to be wrung from him, that he is unequal to the task under present conditions. Therefore, the insurer proposes a programme, defensive and compensatory, in the widening of the perils which are about him—a barrier against the crimes of *over*-insurance, a rescue against the impoverishment of *under*-insurance, a safeguard against the irresponsibility of the insured; in effect, to free the system from any charge of being conducted to benefit the individual at the public loss.

The insured demands lower rates; the insurer asks for less danger. The plan proposed is an adjustment of these contrary demands, and begins with the risks of the manufacturer, as having the greatest physical hazard, which involves a corresponding ratio of personal duty. Now, as net rate equals danger, the control of rates is more within the power of the insured than the insurer, and the demand of the insurer is virtually that the insured *himself* shall reduce rates in the ratio of so much of the danger as is by him removable.

The co-insurance clause simply exempts the underwriter from what he does *not* insure, in a strict application of the insurance principle. When value is $20,000 and insurance $10,000, the insurance attaches *equally* to *all* the partially insured value; covers, in proportion, *every* dollar of value; consequently there is an insurance of fifty cents on each dollar. But, in such a case, by prevailing practice, *one* dollar of insurance is made to cover, in some incomprehensible way, *two* dollars of value, and, in case of partial loss, the insurer *so pays* up to the maximum of the policy. With a $10,000 loss, there is a maximum payment upon a minimum insurance. By the clause named, loss is as insurance, the underwriter paying in the proportion of his policy.

Practically, the co-insurance clause is the protection of the underwriter against the schemes of *under*-insurance by which he pays all the losses on property for premium on but part of the property. It secures a fuller contribution to pay loss, and thereby lessens ratio of premium. Being, however, but a matter of proportion, the percentage of loss payment increases with the insurance, and the clause falls when the insurance is full.

Influencing, as the co-insurance clause does, the extension of the lines of insurance, and in proportion to the reduction of premium, the three-fourths clause in connection with it, operates not merely as a check, but as a preservative of the practical results of the co-insurance condition. Apart from being an obstacle to incendiarism and a preventive of culpable carelessness, perhaps the three fourths clause of the form defined,* in itself, is against the interest of the underwriter. It would not, in the vast majority of cases, limit his liability for loss. It is a gain to him on the side of moral hazard; it is a loss to him on the side of physical hazard. But the three-quarter insurance, in association with the pro rata underwriting, fixes maximums which would otherwise be indeterminate.

With this system it would behoove the underwriter to be more than ordinarily careful as to his *moral* ground, that no popular feeling be excited against him. The indemnity proposed does not fall short of the insurance promised—in cases may be the total of the policy—and the insured should have clear information as to the pro rata of loss payable. Tricks of adjustment, which keep the voice of promise to the ear and break it to the hope, should be sternly frowned down; simple ideas of proportion should not be made complex and intricate by the combined operation of divergent policies, whose non-concurrent *inadjustibility* has been the source of endless disputes and measureless bitterness. With more than a single policy existing, companies should settle their differences among themselves, and in their aggregate allotment to the insured, should let the full total of his insurance measure the pro rata of the indemnity he receives.

——MASSACHUSETTS meets the debated case of an insurance policy, presumably void at common law, with an express statute. Under an illegal policy, whoever pays premium can recover back his money on the ground that there is no consideration—*i. e.*, insurance; so the fact of the premium money being thus recoverable is against the validity of the insurance. But the Massachusetts enactment goes the full length on the side of the policyholder, and accords to him either the premium or the insurance, as circumstances may determine. While holders of policies from State unauthorized companies have thus a more definite legal position in Massachusetts than elsewhere, it appears that those so insured are practically but little better off from the legislative theory of insurance without premium—at least Commissioner Clarke does not give a very favorable account of their security, and besides, the fact that that official may be accepted as a judge of such matters as they appertain to his own territory, there is also the concurrence of the common-sense instinct, that insurance made in violation of law by the maker thereof, cannot be of the safest kind, and that legislative patching cannot make an unsafe thing safe. From a late letter of Mr. Clarke, on underground insurance in his State, we extract as follows:—

"It is a wise provision of law that no insurance company incorporated without the State shall do business therein, until it has complied with certain statutory conditions—in all cases a very simple and inexpensive process for any solvent company to effect. Next to the required financial status, one of the most important conditions is the appointment of a citizen of the State, upon whom all legal processes against the company may be served with like effect as if the company had been incorporated therein; the company stipulating and agreeing that all such processes shall have the same legal force and validity as if served upon itself, and the person so appointed giving bond with sufficient sureties to accept such service. The person accepting such service is holden by his bond so long as the company has an outstanding risk in the State, or until the legal appointment and qualification of his successor. As this condition is observed in the case of every company legally admitted into the State, claims against such companies can be prosecuted in its own courts, and the trouble and expense of going abroad for that purpose avoided. If policies are accepted from companies which have not complied with these conditions, the holders should understand that, in case of controversy or disagreement in the adjustment of losses, they have no protection through the courts of their own State, and must either accept such terms as a company may be disposed to offer, or seek redress in the courts of other States. Cases of this sort have already occurred in Massachusetts, and in one of them an equitable claim of some thousands of dollars has been recently abandoned, because of the annoyance and expense of contesting frivolous objections and obstacles interposed by the company. In another similar case, a Massachusetts policyholder was glad to accept 50 per cent. of an absolute loss, rather than go to a distant State to establish a just claim.

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* Three-quarter insurance is of two kinds: 1. Limitation of amount insured. 2. Limitation of indemnity without express restriction as to sum of insurance. There is a theoretical unfairness in the latter which makes it objectionable, though the practice largely corrects any inequity—heavy insurance counting for nothing, and being, therefore, unnecessary, when, at most, but three-fourths of the loss is to be paid by the company, though to the insurer loss may be *total*.

"The rights and interests of property owners holding policies in companies not authorized in the State are still further jeopardized by recent judicial decisions. Under a provision of the general statutes of Massachusetts, (chapter 58, section 72,) an insurance company incorporated elsewhere, and doing business in this State in violation of law, cannot recover any premium or assessment made by it on any contract of insurance effected with a citizen thereof during the existence of such default. So far, at least, the policy contract is void, and the principle has been affirmed and reaffirmed by the decisions of our own Supreme court. Under the same statute, a contract made without compliance with the laws is held to be valid as against the company, and would doubtless be effective if sufficient assets should be found within the State. But the validity of such contracts in other relations has just now become a matter of important public interest. The general doctrine that they are *wholly* null and void has been clearly recognized by recent decisions in the Kentucky court of appeals, and by Judge Davis, of the Supreme court of the United States, presiding in the United States District court of Indiana. It is unnecessary to cite here the text of these decisions, it being sufficient for the purpose of this communication to know that such a principle has been affirmed in the higher courts of other States. Whether subject to future revision, or not, these decisions are of so much importance that, in connection with other issues presented, every applicant for insurance should carefully consider the many risks involved in the acceptance of policies negotiated in violation of law.

"Such contracts may be fulfilled by a solvent company, *provided* its own interest should dictate that course; but, in view of the decisions referred to, and the fact that a company is willing to evade laws in the first instance, it is fair to presume that its obligations would be lightly considered upon slight pretexts in the last."

——THE charge of over-insurance is made against the fire underwriter with augmenting emphasis, and complaint is taking the form of denunciation as public feeling on the subject intensifies with the conviction that there are too many agents ready to sacrifice not only their companies, but the public safety, for a small addition to their commissions. Generally, it is the worst class of companies among which the practice prevails, as, from the necessity of their position, they are obliged to get premium how and wherever they can, and largely it may be regarded as one of the penalties paid for the senseless hunt for cheap insurance—the cheapness of the insurance being the measure of the character of the companies, and all the motives which justify an under-rate as a venture in speculation, impel to take the chances in an over-insurance. When a respectable office cancels a policy or refuses a risk to avoid insurance beyond value, it is morally certain that some other company can be found by the owner or broker to accept what has thus been rejected.

But, beyond what pertains to the mere riff-raff of the business, excessive insurance pervades too much the entire interest; not that such excess here is in very high ratio, but its ratio of danger to the danger of insurance in just proportion, is beyond all comparison. Of the $6,000,000,000 written against the risk of fire in the United States, it is probable that $250,000,000 will be fully the excess over the aggregate which properly could have been written; but the special peril to the underwriter is not in the $5,750,000,000, but in the $250,000,000. Not only in one twenty-fourth of the insurance is there more fire than in the remaining twenty-three-twenty-fourths, *per se*, but the fire liability of the latter is greatly enhanced. If $10,000 is insured when $9,000 should have been the limit, the $1,000 in excess may burn up the whole $9,000 of value.

If but exceptional, over-insurance is nevertheless widespread in its deleterious influence. The over-insured is a danger to his neighbor; the over insurer is a peril to the company which does not itself over-insure. Hence, this subject reaches a moral responsibility of the underwriter which s beyond the penalty of a financial loss to him, and therefore gives excusable ground for legislative interposition as a need of public safety—even though, as a rule, it must be granted that legislative interference in business matters makes more evils than it prevents.

It is pleaded in extenuation of the neglect of repressive measures against this malpractice, that it cannot be stopped. The animus of this excuse furnishes the reason why it can be. Each underwriter can stop it in his own case, at least so far as to make himself morally right, and therefore the practice outside of this will be clearly defined as a criminality to be taken care of outside of the underwriter. The survey of fire risks may be pronounced a mere measurement of physical fire hazard, without reference to the commercial value of the subject proposed for insurance. The surveyor is a specialist on the average fitted for his line of examination—the physical fire liability, and, we may assume, without special fitness for the extrinsic circumstances which affect the hazard. In most cases he is doubtless adequate for the whole risk, and further inspection would but show that hazard stops with his conclusions; but the environing circumstances must have their due study, and over-insurance is the key to their correct interpretation. Valuation of risk, therefore, becomes the inevitable sequel to the survey, and though not without difficulties hard to overcome at first, these will give way before experience and the development of a system. This valuation lies, too, in the way our fire insurance is going; it has part in the simple postulate in which the fire insurer comprehends his new work and his new exigency, namely, "I must know better what I am doing"—words which are the outcome of trial and repentance, and within whose meaning there is a gleam of the speaker's understanding that his grievings over moral hazard have been an accusation against himself, and that the *permission* of over-insurance has been a social crime and an economic blunder.

——THERE is a sheet published in Hartford called The Insurance Journal. It it a monthly ding-dong about State supervision. Following up its severe and brain-oppressive labors, it discovered a joke in our single article anent its subject. We are glad of this, for it must be a relief to the strain of the heavy mental distress the Journal is undergoing. No one can find any joke in *it;* but possibly there is an attempt at one in an allusion to grammar, which, of course, occurs under the head of Supervision. The Spectator opens a discussion with the statement, "If mankind lived in the Arcadian State, if all men were honest and gifted with wisdom, and were not mentally dependent upon each other, there might be no need for the machinery called government." At this simple and intelligible language, the Journal, in the rôle of critic, gets befogged in this wise:

> Beginning with that wonderful verb-transitive which so often bounds the natural limits of our comprehension, and is in itself such an unsubstantial foundation on which to build, the Spectator proceeds to rear its superstructure. The only inference to be drawn from this "if" is, that the business portion of mankind represented by the underwriting fraternity live farthest from the Arcadian State, that they are not honest, not gifted with wisdom.

To make the conjunction, if, a transitive verb, or a sign of such condition of the verb, is hard upon grammatical etymology; but it's not funny. The Journal opposes statistics—that's a fair fight—statistics are opposed to it; but what has grammar done?

——To "freeze out" is the new term applied to a life office which, dismissing conscience, sets about to replenish an impaired reserve or capital. It takes no stock in the chances of higher interest and less expenses, but goes directly to work, with as little chicanery or deception as a highwayman with a pistol at your head. It leaves policyholders out in the cold, by forcing lapses, through withdrawing from other States, rigid exactions, &c.—doing anything that can make continuance an inconvenience to policyholders. At the worst, or best, however, such a scheme can be only a temporary relief to the impairment; the best lives will readily withdraw, the poor ones *will* stay—till they die. Death will undo what lapsing has done, and as claims multiply, resources will decline. As an expedient to continue an office, nothing more futile could be devised. So apparent is this, that in most cases there will be doubts as to whether any real purpose of the kind exists; and, bad as it may be to purchase corporate existence at the expense of the ruined hopes of policyholders, it will be as honor itself alongside of infamy, in contrast with the only other object which such work can have.

——In reply to some inquiries, we give the text of the reconstructed West Virginia insurance law as the fullest answer:—

An act to amend and reënact section two of chapter thirty-four of the code of West Virginia, and to repeal so much of an act passed February 25, 1871, and of sections three and thirteen of chapter thirty-four of the said code as is inconsistent or in conflict herewith, relating to insurance companies.

Approved, March 29, 1873.

Be it enacted by the legislature of West Virginia:—

1. That section two of chapter thirty-four of the code of West Virginia be amended and reënacted so as to read as follows:—

"2. It shall be lawful for any officer or agent of any fire or marine insurance company, directly or indirectly, to take risks or issue policies of insurance within this State without first procuring from the auditor a certificate as hereinafter directed.

Before obtaining such certificate, such company, its officers or agents, shall furnish the auditor with a statement, under oath of the president or secretary of the company for which he or they may act, which statement shall show:—

First. The name and locality of the company.

Second. The amount of its capital stock.

Third. The amount of its capital stock paid up.

Fourth. The assets of the company, including, first, the amount of cash on hand and in the hands of agents or other persons; second, the real estate unincumbered; third, the bonds owned by the company and how they are secured, with the rate of interest thereon; fourth, debts to the company secured by mortgage or otherwise; fifth, debts for premiums; sixth, all other securities.

Fifth. The amount of liabilities due or owing to banks or other creditors by the companies.

Sixth. Losses adjusted and due.

Seventh. Losses adjusted and not due.

Eighth. Losses unadjusted.

Ninth. Losses in suspense waiting for future proof.

Tenth. All other claims againt the company.

Eleventh. The greatest amount insured in any one risk.

Which statement shall be filed in the office of the said auditor. And no foreign insurance company, or agent thereof, shall transact any business of insurance in this State, unless such company is possessed of at least one hundred thousand dollars of actual capital, invested in the stock or bonds of some one or more of the States of this Union, whose bonds are at par; or of the bonds of the United States at the current market value thereof at the date of such statement; or in bonds secured by mortgage or deed of trust on real estate, within this State, worth double the amount for which the same is mortgaged, free from any prior incumbrance, and having undoubted title. The auditor shall be authorized to examine into the condition and affairs of any foreign insurance company doing business in this State, or cause such examination to be made by some person or persons appointed by him, having no interest in any insurance company. And whenever it shall appear to the satisfaction of said auditor that the affairs of any such company are in an unsound condition, he shall revoke the certificate granted in behalf of such company, and shall cause a notification thereof to be published in some newspaper of general circulation, published at the capital of this State, and the agent or agents of such company are, on and after such notice, required to discontinue the issuing of any new policies, or the renewal of any previously issued. When, by the laws of any other State, any deposits of money or of securities, or other obligations or prohibitions, are imposed, or would be imposed on insurance companies of this State, doing, or that might seek to do business in such other State, or upon their agents therein, so long as such laws continue in force, the same obligations and prohibitions, of whatever kind, shall be imposed upon all insurance companies of such other State doing business within this State, or upon their agents here. Every foreign insurance company doing business in this State, at the time of making the annual statement as required by law, shall pay into the State treasury, as taxes, three per cent. of the gross amount of premiums received in this State during the previous year, taking duplicate receipts therefor, one of which shall be filed with the auditor; and upon the filing of said receipts, and not till then, the said auditor shall issue the annual certificate as provided by law, and the said sum of three per cent. shall be in full of State taxes only: *Provided*, that any foreign life insurance company which shall invest in this State the whole amount of its net receipts from its business therein, shall pay only one-third of the aforesaid rates. No officer or agent of a foreign insurance company shall make, renew, or negotiate, in this State, any insurance, or contract for insurance, on behalf of such company, or transact any business for such company, directly or indirectly, without first obtaining the auditor's certificate of authority, as required by law; and this applies to all persons engaged in any manner in soliciting risks, insuring or obtaining the issue of policies, selling tickets of insurance, or otherwise doing the business of insurance, either by direct appointment from a company or as such agent."

2. So much of the act passed twenty-fifth of February, 1871, and of sections three and thirteen of chapter thirty-four, of the code of West Virginia, as is inconsistent or in conflict with this act, are hereby repealed.

——FRANK NEWLAND, adjudicated a bankrupt by the United States Circuit court, in New York, April 23, 1872, had among the debts against his estate two promissory notes, made for moneys loaned to him by his mother in-law, Lucy Van Antwerp. Amount of the notes $4,000; for which there was as collateral security a life policy for $4,000, payable to Lucy Van Antwerp—policy issued April 18, 1870. Newland paid the quarterly premium on the policy up to the time of filing his petition in bankruptcy, April 16, 1872; afterwards the premiums were paid by moneys furnished by the creditor as the beneficiary named in the policy. At the cessation of payments by the insured, the cash value of the policy was named at $13.13. Before the bankruptcy, $550 of the debt were paid. By agreement between the assignee and Lucy Van Antwerp two questions were submitted to Judge Blatchford, and in his decision he said that the $13.13 were to be credited on the amount due of the debt, and, after making such credit, the debt, less a rebate of interest, stood, for a dividend, at $3,208.20. On that sum a dividend of 20 per cent. was declared, and the amount of such dividend, $641.64, was paid to Lucy Van Antwerp March 18, 1873. She retained the policy, and kept it alive by paying the premiums which afterwards became due. After the dividend was paid, and during the life of the policy, the bankrupt died, and, prior to the declaration of the second dividend, other questions were submitted to Judge Blatchford for decision. The conclusion at which the court arrived was that—

> Lucy Van Antwerp has substantially taken out a new policy since the bankruptcy, and before a second dividend is made, and ought to credit on the debt what she realizes on the policy, beside crediting all other payments on the debt; and when her debt is thus paid she ceases to be a creditor. * * * * * * * * * * *
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> As the credit of the $13.13 was based on the surrender of the policy, that sum ought not to be credited, the policy not having been surrendered. The debt should be charged at its proper original amount with proper interest. Then there should be credited on it the $550 and the $641.64 with proper interest. The amount of the policy, so far as necessary, should be applied to extinguish the balance due on the debt, Lucy Van Antwerp having credit for, and being refunded with interest the amounts paid by her for premiums after the petition was filed, either through the bankrupt or directly. Out of the balance, if any, then left of the policy money, the assignee must be refunded the $550 with interest. It is referred to the register to state and account on this basis.

Now, in connection with this ruling, comes the question, How does it harmonize with the doctrine that the life insurance policy is not a contract of indemnity? and what are the limitations to be set in the United States to the English adjudication that a creditor may continue the policy for his own benefit after the debt is paid? Life insurance is not a contract of indemnity, because it is essentially a contract of purchase, and the legal position of the purchaser should not be affected by the mere profit or loss of a transaction resting originally upon an insurable interest. If otherwise, is not the policy void?

——A CALIFORNIA newspaper asserts its belief that "there is to-day sixty millions of over-insurance on this coast." The writer thereof, we opine, has great faith. This sum represents the fire insurance of California as fully one-fourth more than it should properly be, and as California has one-thirtieth of the fire risks of the country, should a like proportion prevail elsewhere the reader can calculate the amount that must exist throughout the nation: he will find it enough to set twenty United States on fire. Such figures are too suggestive of the approach of the Great Doom to be altogether pleasing, and if their verity applies only to the State of their origin, it may be a satisfaction in some quarters to know, that when creation is to blaze, the flame will begin at the California end of it.

——AFTER blazing Chicago, and the experience therein, in relation to fireproof safes, some one gave it as his deliberate and well made-up judgment, that "a fireproof safe is a good thing in a cool place." This qualification of the goodness of the thing not being heeded in Baltimore, there occurred the incompatibility of a hot stove alongside of an otherwise cold old iron safe, and the result was that the packing between the inner and the outer plates caught—no, spontaneously combusted!

——In the thirty-fourth annual report of the English registrar-general, the mortality for England and Wales is given for the period from 1838 to 1871—that is, as death occurred in a population of 20,000,000 people in a period of 34 years—for ages from and under 15 years, rating in 5-year groups, and above 15 years in 10-year groups. Being the mortality of the general population, it necessarily shows higher death percentages than such tables as rest upon selected lives, but at the same time shows such approximations as confirm the general availability or practicability of the death data of English life insurance.

In respect to the aggregate death movement (distinct from the percentages of the living who die) the Actuaries, New Experience, and Registrar-General's tables contrast as follows—the latter two having the following deaths for each hundred by the Actuaries' table in the grouped ages named:—

	DEATHS.		
Ages.	*Actuaries.*	*New Experience.*	*Registrar-General.*
15 to 25	100	117	118
25 to 35	100	106	126
35 to 45	100	100	122
45 to 55	100	99	107
55 to 65	100	105	105
65 to 75	100	104	103
75 to 85	100	102	106
85 to 95	100	116	112
Annual Deaths for each 1,000 Living.			
15 to 25	6.25	7.30	7.40
25 to 35	7.90	8.40	10.00
35 to 45	10.30	10.30	12.60
45 to 55	15.90	15.80	17.00
55 to 65	28.60	30.00	30.00
65 to 75	60.60	63.40	63.00
75 to 85	131.80	135.20	140.70
85 to 95	260.70	303.40	292.50

The progressive death-rate of the Registrar-General's table indicates that graduation in the life tables has been corrective and compensatory of inequalities of data.

——VOL. II, Part III, of the Insurance Cyclopædia, continuing initial D, traverses the great field of Death, which, as a generic subject, is treated under about twenty-five distinctive titles, with references also to other heads. The way we go and how we go through

> the ever open gates
> which day and night stand ready to receive us.

Besides this elaborate compend all the titles called for come into their places. It is peculiarly interesting to read together the lives of De Moivre and De Morgan, representatives of two different eras of mathematic thought; and between these two biographies, as if to heighten the contrast, is a suggestive historic review of De Moivre's Hypothesis. This part closes with Decrement as defined (in its application to life contingencies) by Dr. Southwood Smith—drawing a radical distinction where it does not exist between the life decrement of the mortality tables and the law of mortality, *i.e.*, between the successive annual deaths of a given number of *births* and the annual deaths from a like annual number of *lives*. Such verbal or formulated distinction but merges into a common result, viz.: Taking the illustration given (and correcting a typographical error) out of a million *births*, the life decrement, from age 1 to 2, is $\frac{27863}{819508}$; and, out of a million *lives* aged 1, the law of mortality up to age 2 is $\frac{34000}{1000000}$; the two fractions being equal quantities.

——THOSE who think higher rates of insurance admissible, have with them, as of like faith, Secretary Richardson. There being a deficiency in the federal revenue, the secretary names his subjects for increased taxation, selecting such as would, in his judgment, be the least burdensome to the people and business of the country, and readily collectible; accordingly, insurance is one of the few selected. So one of the beauties of the insurance premium is its aerial, gossamer-like lightness. Premiums can be gathered in like snow-flakes.

——IN respect to the contract under which the National Life, U.S.A., reinsures the risks of the Commonwealth Life, of New York, the Insurance and Real Estate Journal has the following:—"All policyholders are to be subjected to a medical examination upon being accepted by the contracting company. The National proposes to insure all the risks of the Commonwealth for three years, during which all claims maturing will be paid; but at the close of this period, those risks not approved by the medical examiner when transferred will be returned to the responsibility of the parent company, the Commonwealth, we infer, remaining intact to receive those who may accept such an alternative, undertaking to continue their policies as if nothing had transpired to alter their relations, or they will pay the surrender value of the policies, or, we understand, make any other equitable adjustment that circumstances will justify."

——MEAD & ROBBINS *vs.* The Imperial Fire Insurance Company of London—Nisi Prius, Judge Gordon—policy of insurance $5,000 upon plaintiffs' mill at Ninth and Wallace streets, Philadelphia. Defence denied that policy ever went into effect, averring that the first premium was never paid. Plaintiffs answered that when the agent called upon them to make the insurance it was late in the afternoon, and they told him they could then pay him only ten dollars, and he could receive the balance the next day. He replied that the payment of ten dollars was sufficient, and they paid that sum, he engaging to call for the rest the next day; but, instead of doing so, he went out of the city, and during his absence the fire occurred. Verdict for defendant.

——IN the New York Supreme court, Judge Barrett orders that the department deposit of the Craftsmens Life Insurance Company shall be held by the receiver for the benefit of the policyholders in preference to the general creditors; receiver to be allowed to use the proceeds of the securities to defray the expenses of such suits on policies against the company as in the judgment of the receiver should be defended, but a defence is only to be made in cases where a successful defence would increase the fund left for division among policyholders other than those who bring the suit.

——WHAT has been for some months a foregone conclusion, with respect to the St. Louis Mutual Life, has taken place; it reinsures its risks. The Mound City Life, of St. Louis, takes all the business, though we understand that early in the negotiation there was a proposition by which the Piedmont and Arlington was to receive the Southern risks. The Mound City began business in 1868, and until recently confined its policies to Missouri, the bordering States, and Louisiana. New business on the stock plan. The Mound City proposes to increase its capital to $1,000,000.

——JANUARY 1, 1874, the new Pennsylvania insurance law goes into operation with respect to non-State companies. By the old law a fire insurance company could be admitted to do business in the State with liabilities 30 per cent. in excess of its assets. By the new law assets must equal the liabilities charged against the company, and when the latter absorb 20 per cent. of the capital stock the capital must be repaired, or the business cease. The smaller the stock capital, the sooner a company reaches its limit.

——As between brokers and companies, or their agents, in the fire insurance line in Philadelphia, matters are rather belligerent and uncertain. A National board resolution, to pay no commissions after January 1 to non-board brokers, is a decisive movement, which evinces that the board is working in the consciousness of increasing strength. From this starts a new board of brokers—Wm. A. Simpson, president; Paul Jones Fry, treasurer; James E. McGowen, secretary.

——AT 418 Walnut street, Philadelphia, are new quarters of the Philadelphia branches of three Pittsburgh fire insurance companies, with aggregate assets approaching one million of dollars. The Allemania of Pittsburgh heads the list with $457,000, November 1; and we note as significant of the growth of this company's business, that its assets increased about $50,000 in October. Mr. Wm. C. O'Neill represents the three Pittsburgh companies.

——WITH chemists the subject of spontaneous ignition is largely theoretical, but fire marshals have a habit of deciding about spontaneous combustion which is in marked contrast with the hesitation with which chemists would pronounce judgment. There seems to be a necessity either that the fire marshals should teach the chemists or the chemists should teach the fire marshals.

——An instance of fire insurance, conducted on the basis of personal responsibility, is found in Baltimore. The subject affords ground for considerable discussion, and is prolific in suggestions, upon which we shall not now enter, simply confining ourselves to the facts as recorded by the Baltimore Underwriter, viz.: "The individual who is plucky enough to subscribe his name to a policy of fire insurance for the purpose of becoming personally answerable in case of loss or damage, is one of our old and wealthy citizens, Mr. James C. Wheeden, corner of Broadway and Gough street. Mr. Wheeden was for twenty-five years a member of the board of directors of the Associated Firemen's Insurance Company, and, during that period, was, with rare exceptions, in daily attendance at the office. He confines himself almost exclusively to dwelling-house risks, of which he makes careful surveys, and as he knows everybody in the eastern section of the city, where he has lived sixty-nine years, he has little to fear from the elements of moral hazard. He has successfully conducted his business for more than a year with only one trifling loss."

——The National Fire Insurance Company of Philadelphia has shown a steady growth both in financial condition and in business. The capital has been increased from $300,000 to $500,000. And in addition to this capital the company has a surplus of nearly $200,000. For the coming year the agency operations of the National will be conducted with the same care that has overlooked the past. As a judicious investment, the National will erect a $200,000 building in Chicago, the headquarters of its Western business. This company is also the owner in Philadelphia of the handsome Pictou stone edifice in which its office is located. The company's report of progress in its statement for 1873 will be of peculiar interest.

——In Boston, Elijah A. Shaw *vs.* The Relief Fire Insurance Company, illustrates how quickly fire insurance liability begins. It was an action of contract to recover $5,000 for loss of goods by the fire of November, 1872. The plaintiff alleged that he agreed with the agent of the defendant insurance company in Boston on October 15, 1872, to insure his stock of boots and shoes in the store of Mr. Ball, at 75 Pearl street, to the amount of $5,000 for one month. Defendant denied that there was any agreement to insure, admitted that there was a talk as to insurance, but no bargain, and no terms fixed upon. Jury brought in a verdict for the plaintiff, $5,241.

——Charles J. Hess was general agent for Ohio of the Protection Life Insurance Company of Chicago. He has $11,747, for which the company brings suit. Mr. Hess admits having the money, but says the Protection has collected the amount of several death losses in Ohio, and now refuses to pay over the money so collected to the claimants. In consequence, suits have been brought against the company at Portsmouth, Scioto county, and writs have been served upon him by the sheriff directing him to pay over no money belonging to the company until such suits have been determined.

——Between the Mutual Benefit Life Insurance Company and William Charles, this company's late general agent for Illinois, there is a difference of opinion, and this difference amounts to $51,160.41. The company brings suit to recover $21,502. Charles files his answer, setting forth his original contract, and alleging acts of the company contrary to his contract rights. His interest under the contract is valued by actuary Kellogg at $51,160.41. Mr. Charles holds $20,352.27, collected by him as agent, and asks for a decree for the company to pay the balance of $30,808.13.

——Out of the Philadelphia board and broker fire insurance feud there came a small game of fisticuffs the other day. A. and B. came up to the scratch. A. got in on B.'s cheek. First blood for A. B. countered on A.'s smeller; a wild rally, and A. down; then a tussle and an alderman. It was a poor display of the science. An old member of the P. R. was utterly disgusted at it.

——A. L. Hathaway, *alias* B. F. Armitage, has been arrested on the charge of delivering what purported to be policies of different fire insurance companies and receiving premium thereon. This old swindle seems to be immortal; sometimes it is diversified by the delivery of policies of non-existing companies. Those who deal with duly advertised agents are not liable to such impositions.

——A flying report reaches us as we close this department that the Missouri insurance commissioner has revoked the certificates of three New Orleans companies.

——The French insurance company, La Caisse Générale des Assurances Agricoles et des Assurances contre l'Incendie, having achieved a great success in France and on the continent, enters the American field. Messrs. Wm. Nevin Kremer and James L. Ferriere, directors of the American department, headquarters at Philadelphia. La Caisse Générale is an important acquisition to the security of American fire insurance. Capital $2,500,000; assets, nearly $5,000,000.

——The superintendency for Pennsylvania of the industrial department of the Missouri Valley Life Insurance Company has been assigned to Mr. Eugene L. Townsend by C. E. Rollins, general agent. There was some question as to the propriety of the engraved bank-note form of the company's industrial certificate—$100 insurance; but any doubts as to this point have been set at rest by a letter of the comptroller of the currency to the Continental Bank Note Company.

——The fire and marine insurance companies of the United States, according to the Spectator, numbered, September 1, 724, with $250,914,953 of assets, including premium notes of mutual companies. The aggregate was divided as follows: Stock companies, 438; capital, $100,045,192; assets, $170,110,529. Mutual companies, 286; assets, $80,804,424

——Mr. George P. Treadway, an active underwriter of Chicago, associates himself in business with Mr Samuel T Cockey, the prior firm of Treadway & Jewell having dissolved. The new firm of Treadway & Co. starts with two Pennsylvania offices. As a representative of Pennsylvania companies Mr. Treadway has given satisfaction.

——Of the fifteen New York life offices reported as having capital stock impaired, December 31, 1872, by the New York department, six have been discontinued by reinsuring or otherwise; the Asbury ceases to issue new policies; and the World Mutual is the subject of reinsurance rumors, which are denied by the officers.

——J. B. Bennett takes the position of general superintendent of agencies for the Western States of the Continental Fire Insurance Company of New York. There is a prevailing good feeling toward the once "Napoleon of fire insurance," and the wish is general that on his return from Elba he may meet no Waterloo.

——An examiner from the Ohio department found the German Fire Insurance Company of Erie, Pa., impaired 20 per cent.; and the same department found the Farmers, Merchants, and Manufacturers', of Hamilton, Ohio, impaired 32 per cent. Both companies were ordered to make up their respective deficiencies.

——Mr. David Campbell, secretary of the Iron City Fire Insurance Company of Pittsburgh, has been on a visit to the Philadelphia department of the company's business. Mr. Campbell blends in one the intelligent gentleman and well-informed underwriter. The Iron City is prospering.

——Mr. E. F. Beddall is now associated with Mr. A. B. McDonald as joint-agent of the business of the Royal Insurance Company for the cities of New York and Brooklyn. Of the $12,000,000 assets of the Royal, $1,300,000 are now held in the United States.

——Defence, *delirium tremens*, in a suit brough against the National Life, of Chicago—policy on life of C. S. Forsyth—in favor of his daughter, a minor. The insured died six months after issue of policy. Verdict against the company, $4,302.

——The Hope Mutual Fire Insurance Company of Philadelphia has been adjudicated bankrupt by Judge Cadwalader, of the United States District court. Claim of William A. Levan, of the Pennsylvania oil district, for $500.

——Conjecture is a little busy as to what will be the result of examination of New Orleans companies now in progress. Connecticut, New York, and Illinois State departments, have their representatives on the ground

——Of the life insurance companies winding up in 1873, three were reinsured in the National Life Insurance Company of the United States, viz.: Excelsior and Commonwealth, of New York, and Delaware, of Wilmington.

——Having been duly authorized to transact business in Pennsylvania, the Workingmen's National Fire Insurance Company of Louisiana has appointed C. E. Rollins, Philadelphia, manager of its Eastern department.

——Messrs. Whiton & Tredick, Philadelphia, well known as the active Pennsylvania agents of the New Jersey Mutual Life, will, in the coming year, add a general fire business to their operations in the life branch.

——The secretary of the Eureka and Boatmen's Fire and Marine Insurance Companies of Pittsburgh, Robert Finney, confesses to a defalcation to the amount of $175,000 of the two companies' funds.

——J. B. Carr, Philadelphia, life insurance agent and fire insurance broker, removes his office to more commodious quarters, 416 Walnut street. Mr. Carr's increase of business called for the change.

——The shares of the Hartford Life and Annuity are offered at 70. There is a report that the company proposes to "recuperate" its impaired capital, and the way thereto excites attention.

—— Benjamin Lombard has resigned the presidency of the National Life Insurance Company of Chicago. Superintendent Church has revoked the license of this company to do business in Ohio.

——The New Jersey Fire and Marine Insurance Co. of Camden has taken a Walnut street (Philadelphia) office, which it will occupy early in January, as the central point of its 1874 operations.

——Mr. Beard, receiver of the National Life, of New York, reinsures the outstanding policies in the American National Life and Trust, of New Haven. Losses, &c., to be paid in full.

——In the dissolution of the firm of Rood & Hawley, Philadelphia, the agency of the Phœnix Mutual Life Insurance Company of Hartford continues with Mr. Rood.

——Jonathan O. Halsey, an earnest and capable worker in the life insurance interest, has been appointed special agent of the Manhattan Life.

——The Pennsylvania agency of the Great Western Insurance Company of New Orleans goes to Jacob Schlaudecker, of the German, of Erie.

——Now the carriage manufacturers propose an insurance company to cover the fire risks of their establishments throughout the country.

——C. E. Rollins accepts the agency of the Eastern department of the Mercantile Fire Insurance Company of Chicago.

——The People's Fire Insurance Company of Philadelphia has appointed Mr. J. P. Ramsey agent at Houston, Texas.

——Suits against the makers of premium notes to mutual fire insurance companies are now unusually abundant.

——Cotton-gin houses burn in Georgia at the rate of thrity a month.

RAILWAYS AND TRANSPORTATION.

WHILE trying to estimate the future earnings of the railroads of the country is in the best and at all times a very uncertain operation, sufficient time has elapsed since the monetary disturbance now afflicting all business began, to ascertain with some degree of exactness the ratio of decrease, and perhaps to estimate approximately what may be expected during the winter now upon us.

From the published reports of twenty-six of the leading railroads of the country of their earnings in the month of October, it appears they earned in the aggregate $14,815,071, against $14,570,546 in October, 1872—an increase of $234,525, or 1⅝ per cent. These apparently increased earnings, however, are not really so, as the increase of mileage more than kept pace with the earnings; the aggregate mileage in 1873 being 15,810, against 14,656 at the same time in the previous year—an increase of about 8 per cent; the earnings per mile for the month in 1873 being $937, against $995 in 1872. Twelve out of the twenty-six roads show an increase ranging from 1 to nearly 50 per cent. in earnings, while fourteen show a decrease of almost as great diversity. There is much in these figures which might be better, but there is certainly no cause for despondency; for even at this rate—$937 per mile—the average earnings for a year would be over $11,000 per mile, and these are large earnings as railroads go, and amply sufficient when the business shall have assumed its proper level, and the art of so operating them as that the running expenses shall not exceed a proper ratio of the receipts, to enhance the value of this species of property, and make railroad stocks and bonds a permanent and profitable investment. October is usually one of the best months of the year, and this must be taken into account in estimating the actual falling off in receipts; but, on the other hand, a very large amount of grain and cotton still remains to be moved, and it is not at all improbable that the trade will continue exceptionally active for the winter, and quite up to any previous year. The early closing of the water routes will certainly have a tendency to increase the business of railways; and most of the companies are, by reason of their reduced expenditures, and the relatively increased value of the circulating medium, able to do all business which may be offered much more economically than before, and unless these advantages should be nullified by a decrease in the rates of transportation, of which there seems no immediate danger, although of course it may be brought about, the outlook is not unfavorable, especially for the older lines, whose traffic is well established.

In this connection a look at the number of railways which have defaulted their half-yearly interest, payable in November, may not be without good results. The number of the more prominent roads which have made default is thirteen; though but few of them would, considering their former situation, have been expected to do otherwise, even in comparatively easy times, they being mostly of a class which have always from their commencement labored under disadvantages. The total amount of the defalcation for the thirteen roads is about $1,840,000, estimated in currency. This outlook seems worse than it actually is. In almost, if not quite every instance, each one of the defaulting roads was engaged in renewing worn-out portions, or making large expenditures in completing its line, and in many instances doing both; and this, too, without having had time to establish its business, and whose receipts could not, from the nature of things, have much exceeded its legitimate expenditures. Perhaps the greatest default of all, under the circumstances, was that of the Chesapeake and Ohio railroad. Its stockholders were, in the main, understood to be wealthy men, and the securities were held in high esteem both at home and abroad; but, notwithstanding all this, the money was not forthcoming, nor could it be on this or any other road so situated without having had time to establish its traffic, and an effort is now being made to effect an arrangement by which the company can gain two or three years' time, which is, perhaps, the best that can be done. Taking the whole situation, then, there is no reason for supposing that the future of any of the new trunk roads is at all gloomy, viewed as sources of future income to the stockholders—certainly not near so bad as were almost every new road thirty years ago.

——NOVEMBER 12th, the governor of Michigan, accompanied by the railroad commissioners of that State, started to inspect the last section of the Grand Rapids and Indiana railroad preparatory to acceptance, which is necessary previous to transferring title to the lands granted for its construction. The section inspected, the construction of which terminates the contract of the Continental Improvement Company, carries the road to the end of the land grant, and is from a point 2 miles south of Fyfe lake to Petroskey, at the mouth of Bear river, on Little Traverse bay, and is 35 miles in length. Immediately upon the acceptance of this section the company will come into possession of the remainder of the land grant, which, from the latest reports, seems quite valuable. The total length of the road, is now from Fort Wayne to Petroskey, about 300 miles, though the section just inspected is not provided with side tracks or water stations, and will not be operated until spring. The total land grant is 1,160,382 acres, and of this there have been sold since the opening of the companies' land office at Grand Rapids in 1870 upwards of 100,000, at an average of about $14 per acre. The lands are situated in the counties of Kent, Montcalm, Newaygo, Mecosta, Lake, Osceola, Clare, Wexford, Missaukee, Grand Traverse, Kallaska, Antrim, and Charlevoix, and embrace every variety of soil and timber. It is proposed at an early date to continue the road from Petroskey to Mackinaw, a distance of about 60 miles; and then, in addition to the local traffic which may be expected, the road is so located as to form the natural outlet from the iron and copper region, and indeed the whole northern peninsula of Michigan, which must make the investment profitable as soon as any business becomes profitable.

The financial condition of the company at the close of 1872 was as follows: Capital stock authorized by charter, $2,800,000; paid in, $2,279,575; funded debt, first mortgage 7 per cent. gold bonds, $8,000,000, one-half of which are guaranteed by the Pennsylvania company; total stock and debt, $10,279,575. This amount represents the cost of the road, with the rolling stock, &c., from Fort Wayne, Indiana, to Fyfe lake, 264 miles—an average of about $39,000 per mile. An issue of $1,200,000 equipment bonds has been authorized, but none had been issued several months after the date of the report, and we have no information that any have been issued since. The gross earnings during the year were $1,056,232.94, and the expenses for operating, maintenance, &c., were $593,920.91, leaving net earnings $462,312.03. The company, however, reported payments for expenses other than above specified, $173,037.44, and for interest on the bonds, $537,900, and thus must have received $248,625.41 from some other source, probably from land sales. The contract with the construction company was to have the road completed to its present terminus June 1, 1874, and the construction company was to receive for this $5,000 in stock and $25,000 in bonds per mile, it having the control and operating of the road until that time, and receiving the land grant and paying the interest accruing, due upon the company's bonds. The traffic so far has not been large, but, from the best information attainable by us, the road cannot but prove a paying one before many years.

——THE Boston and Providence Railroad Company directors held their annual meeting November 19th. The business of the company during the year has been unusually prosperous, the revenue being the largest ever received. Gross earnings, $1,822,108.18; increase over last year, $105,708.70; net income, $397,105.10—$385,000 of which constitutes a 10 per cent. dividend upon its capital stock of $3,950,000. The company has purchased during the year the Stoughton branch, the Providence, Warren, and Bristol, and the Fall River, Warren, and Providence roads; bonds for $500,000, for the purpose of paying for these roads, were issued and readily sold at a premium.

——After a struggle of several years' duration, Cincinnati has finally triumphed over most of the opposition, and now the Southern railroad, designed to connect the city with the South, will be constructed as soon as the preliminaries can be arranged. The trustees, who have the matter in charge, are now actively at work settling all questions of right of way likely to arise during the progress of the work. The proposed route is very popular throughout its entire length, and nearly everyone seems to recognize the policy of liberality, and but few questions appear likely to arise to trouble the trustees. The Roane Iron Company has given the board ten acres of land in the city of Chattanooga for a depot, &c., and twenty acres at Rockwood for similar purposes, besides granting the company a right of way through its 15 miles of Tennessee River Valley surveys, and donating 1,500 acres of coal and timber land near the line of the road in Roane county, Tennessee. Other parties have also made donations hardly less munificent, and the Newport and Cincinnati Bridge Company has offered the railroad company the use of its bridge over the Ohio river, and the proposition is under consideration. The present idea is to build a road south from Cincinnati to Chattanooga, passing, by way of the Burnside military route, through Lincoln county, Kentucky, where it will be necessary to construct a tunnel nearly 4,000 feet long through King's mountain, about twelve miles south of Stamford. The trustees, having advertised for proposals for constructing this tunnel, awarded the contract December 10, 1873. An agent has gone to Europe to negotiate the bonds of the city of Cincinnati, for the purpose of procuring funds to prosecute the work. Unless the proposed road should be unusually expensive to build, it ought to be a good investment, not only for Cincinnati capital, but of itself. It will furnish a short route between that city and the South, and another line running further north, *via* Knoxville, would make a very direct route between the grain fields of the West and tide-water at Norfolk, Virginia; both these routes would open up a region very rich in minerals, at present entirely undeveloped for want of an outlet. It would seem as though Cincinnati was not moving any too soon, although just now the times are most unpropitious.

——A fireless locomotive is employed upon the tramways of the city of Chicago. The motive power is in front of the cars, contained in a small, compact, and neat engine, manipulated by an engineer. It consists of a boiler 8 feet long by 3 feet diameter, and the usual driving mechanism on a reduced scale. There is no fuel, no fire, and no fireman. The steam is supplied for the round trip of 6 miles before starting. At the depot is a supply boiler 16 feet by 3 feet, in which steam is generated until a pressure of 200 pounds is registered upon the pressure gauge. The locomotive boiler is three-fourths filled with cold water. Instead of boiling thus by means of a fire, and raising temperature to the required height to effect the generation of steam, the steam from the supply boiler is introduced into the locomotive boiler through a connecting steam-pipe. This supply pipe runs beneath the water along the bottom of the locomotive boiler, and introduces the steam as it is freed from the supply boiler into the other. This steam, rising through the cold water, permeates it, and rapidly stores up a pressure of 170 pounds. With this initial supply of pressure the locomotive regularly draws a heavy four-horse car three miles within ten minutes. In the recorded observation, from which we derive our information, the amount of steam consumed represents 80 pounds pressure, the engine starting back with 90 pounds pressure still available. When the starting point was reached there were still 57 pounds of steam in the boiler, the pressure having been reduced during the return trip (which was down grade) only 33 pounds. It must be borne in mind that attached to the engine there was a large and heavily laden car, with which a speed of 18 miles per hour was maintained.

——The constitutionality of the act of congress passed last session, rendering it incumbent upon the Pacific railroads to carry government goods free of direct cost until the bond account of the government is squared, is in a fair way of being tested in the courts. The government shipped a quantity of cheese from Baltimore to San Francisco early in the year 1873, on account of the subsistence department of the army. Upon the arrival of the goods at San Francisco the government officers refused to pay the freight, and the Central Pacific Railroad Company retained the goods, whereupon a replevin suit was brought by the government, and the question is thus raised.

——The Hoosac tunnel was opened November 27. When fully enlarged to its intended size it will be about 26 feet wide, 23 feet high, and a little less than five miles in length. Every exertion will be made to so far complete the work that it will allow the passage of trains July 4, 1874, but in order to do this much work remains to be done. A great deal of rock cutting is still necessary to enlarge the tunnel throughout to the required dimensions, and in places the roof must, where the shelly rock was encountered, be supported by a substantial arch of masonry. Several drains are also to be built. The one from the highest portion of the tunnel will be carried to the east end by a drain-pipe laid several feet below the floor. Another, leading to the west end, will be covered by flagging. The arches for the portals are still to be constructed; and the tracks for the railway of course are to be laid. The nature of the rock to be penetrated rendered the progress of the tunnel very slow and laborious in the earlier history of the undertaking, when hand drilling and blasting with gunpowder were the means employed; but, since the year 1866, the introduction of the Burleigh rock drills, driven by compressed air, and the use of nitro-glycerine, aided very materially the progress of the work; and, indeed, it may be said that, without these powerful engines, the ultimate completion of this arduous undertaking would have been very doubtful.

——From the lately published report of the operations of the Baltimore and Ohio Railroad Company, for the year ending with September, 1873, we make the following condensations: Length of road operated, 959 miles; gross revenues for the year, $15,695,541.54—$2,068,864 more than the previous year, and about $16,841 per mile; aggregate working expenses were $10,137,052.64, 64.58 per cent. of gross earnings, and exceeding those of previous year by $1,769,577.65, equivalent to a trifle over 3 per cent. The liabilities of the road at the last report were given at $56,014,480.54—this including profit and loss, $26,152,269.36, and the assets at the same figures, in which the cost of the road is put at $39,166,606.91.* During the year the liabilities have been increased, by preferred stock, $15,100; sterling loan, redeemable in 1902, $8,228,000; total, $8,243,100; and the remainder of the second mortgage bonds of the (now) Parkersburg Branch Railroad Company, which matured January 1, 1873, and were guaranteed by this company, $453,500, have been paid off. The profit and loss account shows an increase for the year of $2,882,134.35, and the surplus fund now amounts to $29,034,403.71. This report shows that the prosperity of the company is continued, and seemingly rests upon a solid basis.

——If a late decision of the Supreme court of Illinois is finally sustained, purchasers of municipal bonds issued in aid of railway construction must look closely, or they will be without remedy upon them. A suit was brought to enjoin the town of Ottawa from collecting a tax to pay the interest on certain bonds issued for such a purpose, and the court decided that the bill was passed by one branch of the legislature, read the second time in the other house, then referred to a committee, and reported back to the house in which it originated as "passed," while there is no record that it was ever read a third time in the senate, or was ever passed therein; and therefore it is no law, and the bonds issued under it are void. The bonds were issued in aid of the Ottawa, Oswego, and Fox River Valley railroad, and about $456,000 of bonds were issued; but it is not certain that they were all issued under the law declared irregular. The case will, it is said, be taken to the Supreme court of the United States.

——The treasurer of the Boston and Albany railroad has advertised for proposals for $1,000,000 of the company's bonds. The proposed issue is to bear date February 1, 1872, have 20 years to run, and bear interest at 7 per cent., payable semi-annually. At the last report, the capital stock amounted to $19,664,100, and the funded debt $3,037,000. After the issue of the proposed $1,000,000, the funded debt will only amount to a trifle over $16,000 per mile of road owned. The sinking fund at the close of the last fiscal year amounted to $1,658,431. The gross earnings for the last fiscal year are given at nearly $35,000 per mile, and with the reputation which the road enjoys there will probably be no trouble in placing the loan.

PATENTS, ARTS, AND SCIENCE.

[This Department is under the editorial charge of WILLIAM H. WAHL, Ph. D.]

A LIMIT appears to have been reached in the declining prices of iron, notwithstanding the inactivity which attends the closing of the year. For the various grades of American pig there is a better inquiry. Little movement in Scotch pig. Direct shipments of Scotch pig to Philadelphia in November, 432 tons. Total shipments, 54,525 tons, against 57,484 tons like month last year. Light stock in New York. Sales of merchant bar limited, being held for an advance; mills generally running on half time.

The improvement in money is not without effect on the general tone of the market, which is firm at the advance quoted.

November–December Iron Report.

	29th.	6th.	13th.	20th.
AMERICAN FOUNDRY PIG:—				
Lehigh, No. 1	$32.00	$32.00	$32.00	$34.00
" No. 2	30.00	30.00	31.00	32.00
" " (plain)	28.00	28.00	29.00	29.00
" No. 3 (gray forge)	27.00	27.00	28.00	28.00
" No. 4 (mottled)	26.00	26.00	27.00	27.00
" White	22.00	22.00	24.00	24.00
Schuylkill, No. 1	31.00	31.00	32.00	33.00
" No. 2	29.00	29.00	30.00	31.00
" Gray forge	24.00	24.00	25.00	27.00
" Mottled	23.00	23.00	24.00	26.00
" White	22.00	22.00	23.00	24.00
SCOTCH PIG:—				
Gartsherrie	44.10	44.53	44.42	43.92
Coltness	44.73	45.17	44.94	44.45
Summerlee	42.98	43.75	43.47	43.39
Langloan	43.47	43.75	43.47	43.39
Calder	42.98	43.75	43.47	43.39
Carnbroe	42.98	42.85	42.98	42.35
Glengarnock	42.98	42.85	42.98	42.62
Eglinton	42.47	42.47	42.46	42.09
Dalmellington	42.47	42.72	42.72	42.09
Old rails, D.H.'s	36.00	38.00	38.00	40.00
" T's	35.00	37.00	37.00	39.50
English rails (ex. ship.)	63.00	65.00	65.00	67.00
American rails (manufact'd in Penna.)	62.00	64.00	64.00	66.00
No. 1 Wrought scrap	36.00	38.00	38.00	40.00
Cast scrap (machinery)	22.00	24.00	24.00	26.00
Stove-plate scrap	19.00	21.00	21.00	23.00
Wrought turnings	20.00	22.00	22.00	24.00
Cast "	16.00	18.00	18.00	20.00
American refined bar	3c.	$3\frac{1}{10}$c.	$3\frac{1}{10}$c.	$3\frac{1}{8}$c.
" common bar	60.00	60.00	60.00	62.00
Railroad spikes	.03½	.03¼	.03¼	.04
Nails (℔ keg)	4.25	4.50	4.50	4.75
Street rails (deliv'd on car, Broad & Willow)	68.00	69.50	69.50	71.50

——It is somewhat surprising that a question of such paramount importance as the influence exerted by cold on the physical properties of iron and steel should still remain in the field of conjecture. Some time ago, however, several papers appeared, treating the subject more or less elaborately; but, so far from setting the matter at rest, their experiments have led their authors to very contradictory results. The general course of these experiments was that of selecting suitable pieces of wrought and cast iron and steel, and placing half of the number of each variety in a freezing mixture, while the others were kept at the ordinary temperature. A cold and warm piece were now alternately subjected to a transverse strain, and the amount of weight required in each case to break them was noted. The effects of a sudden blow are likewise noted, by allowing a weight to fall upon the test pieces from varying heights.

The investigations of Sir William Fairbairn and Dr. Joule indicate that temperature has little or nothing to do with the strength of the material. The breaking strain, indeed, was found to be slightly greater in the cold than in the warm specimens. The results here announced were found to hold good of cast and wrought iron as well as steel. Mr. Peter Spence, who has experimented with cast-iron bars, indicates, likewise, that reduction of temperature increases the strength of the material. Wm. W. Brockbank, however, who has experimented with cast-iron bars, declares, for his result, that cast iron suffers a considerable diminution in strength and elasticity when the temperature is reduced below the freezing point—a decision precisely the opposite of that arrived at by his fellow-investigators pursuing the same general method of inquiry.

The explanation of this non-conformity of results we have little hesitation in assigning to a constant and neglected source of error in the mode of conducting the research, which must, until proper weight is assigned to it, render the announcement of any general result hazardous and unreliable. This source of error resides in the want, or rather the entire absence, of attention bestowed on the chemical character of the materials employed. The very important influence exerted upon the quality of irons (and especially upon those very properties, the conditions of which are the subjects of the discussion), by the presence in them, in greater or less amount, of phosphorus and sulphur, is too well known to need anything more than mere mention; and, for aught that has been shown to the contrary, the brittleness or tenacity of each variety may, as the temperature diminishes, be either increased or decreased, according to its chemical composition. This, indeed, in view of the evident care with which the investigations referred to are conducted, seems to be the most rational method of accounting for the contradictory nature of their conclusions. Until, therefore, these and similar investigations into the physical properties of irons are accompanied with an accurate chemical analysis of the sample pieces, the questions involved must be regarded as still unsettled.

Apropos of a related subject, Mr. Alexander L. Holley, at the recent meeting of the American Society of Mining Engineers, read a paper, the object of which was to show why mechanical tests of steel, as ordinarily made, are not *alone* of any special value to engineers, and certainly not to general mechanical engineers. Referring to a very elaborate report of Sir William Fairbairn upon the transverse, tensile, and compressive resistance of certain brands of steel, Mr. Holley remarks: "This is very well—indeed it is indispensable so far as it goes; but it goes no further than to inform the ordinary engineer that there is an unknown substance which possesses these physical properties. As to *what* the substance is, the report gives him no working knowledge, for not a single chemical analysis is given of any of the bars tested. The most that is said of some of them is that they are either 'hard' or 'soft,' which is sufficiently evident from the experiments. 'A bar of steel' is, in the present state of the art, a vastly less definite expression than 'a piece of chalk.' To the engineer, who wants steel for a specific purpose, it gives only the faintest clue to say that steel is hard or soft. There are a dozen grades of both hard and soft steel adapted to different purposes. Rail steel is soft, and boiler-plate steel is soft, as compared with many structural steels, and with the whole range of spring and tool steels; but the one perfectly adapted to rails would be useless for boilers. In order that engineers may know what to specify, and that manufacturers may know not only what to make, but how to compound and temper it, the leading ingredients of each grade of steel must be known. Pure iron would be unfit for nearly all structural purposes.

Upon the substances associated with it depend its hardness, malleability, stiffness, toughness, elasticity, tempering qualities, and adaptations to various structural uses.

"When we consider that two or three-tenths of one per cent., and in some cases a fraction of a tenth of one per cent. of foreign metals, will change the character of steel in a high degree, and when we further consider that the physical results of these combinations have never been tested or analyzed in any thorough and comprehensive manner, we may well reiterate the common expression that the iron and steel manufacture is in its infancy. The trouble is that neither the user nor the maker knows what the material *is*. They have put no mark upon it by which they can recognize it; they have kept no recipe. All they can do is to use ingredients of the same name, and approximately of the same quality, and to guess at the physical properties of the product, aided by such crude tests as can be made during manufacture."

After urging the vital necessity of making numerous analyses of the various grades of steel, in order that the steel-maker may have a recipe for making it, the paper concludes with the following: "But steel-makers will find that working by analysis is not so very formidable after all. The color test for carbon is already applied to all charges of all Bessemer and open-hearth makers, and it is one of the most important. There is another view of the case—after a certain experience in comparing mechanical tests which are comparatively easily made, with the more costly estimations of manganese, phosphorus, &c., the expert will not need to analyze every charge. He will learn to read manganese approximately in an elastic limit test, just as an expert blacksmith can now read carbon approximately by the water-hardening test. Herein will lie one of the values of the combined chemical and mechanical tests—that they will supplement and prove each other."

——The measure of civilization, it has been well said, is gauged by the progress made in the utilization of waste products. Progression in this field has been the preëminent characteristic of the past few decades. To illustrate this theme, there are several striking examples which can be adduced, and which have often served to point a moral. The refuse coal-tar which accumulates in the manufacture of illuminating gas from coal, was for years so pestilent a nuisance as to have been repeatedly the subject of legislative enactment. Now, the aspect of the case is changed. At first, small quantities of the substance were employed as a paint or protecting covering for the iron and other parts of constructive work; then came the discovery that the distillation of the substance yielded several other substances, which could be advantageously employed. One of these is now largely used in the various processes for the preservation of wood; another of the distillates finds quite as extensive utilization in removing stains and grease from textile fabrics. Subsequently to these advances came Hoffman's discovery of the aniline colors; and from this uninviting, not to say disgusting product, are now obtained a whole host of brilliant colors, unrivalled by anything which has preceded or followed them: and, last of all, comes the great discovery of the German chemists, Graebe and Liebermann, that the portion of this refuse left over, after its treatment for the anilines, contains the materials from which alizarine, the coloring principle of the madder-root, may be extracted. This discovery has borne the most practical fruit; for, to-day, not only is the artificial alizarine largely employed in dyeing, but its manufacture has assumed commercial proportions, so important as to leave no doubt that the extinction of the industry devoted to the cultivation of the madder-root is but a question of time.

——It is only a few years since nickel assumed any importance in the industrial arts, and now the demand for it largely exceeds the production. The annual production of nickel is not more than 600 tons, and of this, it is estimated, the English industries use more than half. In Belgium, Switzerland, and the United States, nickel is used for coinage; and it is urged, if nickel money were to be adopted in Germany, the industry would suffer severely. If nickel were abundant, it is probable that it would be much more largely used in the arts than at present. Its tensile strength is nearly one-third higher than that of iron, which metal it resembles in many respects, but it is much less liable to oxidation than iron under the influence of air and water. German silver is simply brass, to which sufficient nickel has been added to give it the appearance of silver, and superior qualities of resisting the action of chemical agencies. The covering of other metals with this alloy, it appears, has become quite an important industry in Germany and elsewhere.

—OFFICE OF AMERICAN TUBULAR IRON AND STEEL ASSOCIATION,
220 WALNUT STREET, PHILADELPHIA, December, 1873.

To the Editor of the American Exchange and Review:—

Agreeable to your suggestion we send you the following brief description of our process for the production of tubular iron.

A great deal has already been said upon the subject of tubes; they are not a new article of manufacture as they have been made for a long time, and used for a great many purposes, such as gas pipes, boiler tubes, and for many other uses where they are not required to be very heavy; and, although they are common, the process of manufacture is not generally understood, from the fact that pipe and tube makers are not willing to admit parties to their works to see the process.

The invention is an English one, and consists in taking a thin, flat bar, or skelp, and bending it to form, and then welding it in tongs, or over a ball and mandril: the one over the ball is lap-welded; the one in tongs is butt-welded. Gun barrels have also been made over a mandril; and cast iron pipes, columns, &c., are very common, made in the form of a tube.

The expense of making wrought-iron tubing by the mode of manufacture above described is very great, and increases in cost to almost prohibitory prices as the extra weights are demanded, running as high in some instances as fifty cents to one dollar per pound.

I have said this much in relation to tubes and their manufacture in order to show the difference in manufacture and construction of tubes proper and what we term tubular iron: the one made and gauged by the interior diameter of tube; the other, namely, tubular iron, made and gauged by the exterior diameter without particular regard to the interior diameter. Tubular wrought iron, to take the place of solid wrought iron, must of necessity be made to cost no more per linear foot than solid iron, which is the all-important feature in our process for the manufacture of tubes or tubular iron. It is well understood by every practical engineer that a properly proportioned tube is stronger and safer under vibratory strain than a solid bar, and we will contract to make them by our process for the same price per running foot. Car axles, shafting, columns, and all other heavy tubing, which would cost by the old process four or five prices, or four or five times as much per foot as the solid bar, can be produced by our process at the same price per foot. Now, if it is stronger, safer, less liable to crystallize, we see no reason why it should not be adopted. Take a car axle, for example, which could be made as strong, safe, and reliable, with 25 per cent. less weight, would save so much motive power as is required to propel the extra weight. It is estimated, by competent engineers, that it costs one cent per ton per mile to move dead weight. There were, in June last, about 340,000 cars in the United States—an aggregate tonnage of 204,000 tons of axles—25 per cent. of which is 51,000 tons; if it costs one cent per ton per mile, and a car travels 20,000 miles per year, we have the cost of $200 for moving one ton one year; multiptied by 51,000 tons, we have a saving in the aggregate of $10,200,000 per annum.

To make tubular iron by our process we first roll segmental circular bars, one set for the interior, another for the exterior of the pile, taking care in piling to have one set lap or break joints over the other; these two segments are piled over shorter internal bars or rings, or rings and bars. The bars are made at the same heat that the iron is of which they are composed, and should cost no more than the ordinary flat bars of which solid iron is made. The rolls by which the segmental bars are made are special ones, for which we have a patent, and also patents for the pile and tube, with varying diameters, as a new article of manufacture. In heating and welding the hollow pile has great advantage over the solid, especially in heating, on account of presenting two surfaces; that is, we heat from the outside and inside at the same time. In welding, the outer and inner segments, piled over the shorter segments and rings, form a very strong arch, which is maintained throughout the welding and reduction of the pile, and produces a tube, not only lap-welded, but also a tube with varying diameters, which could not be produced by either of the old processes, and which is produced by our process without any internal former. The best evidence that the making of tubular iron without any internal former is new, is, that, heretofore, there has been no production of such iron.

Very respectfully yours,

E. WHEELER, Vice-President.

——In Prof. Frederick Guthrie's lecture to workingmen on the Expansion by Heat, which we reprint from Iron, he showed that true gases expand nearly precisely the same fraction of their size for the same increase of heat, each cubic foot of gas at the freezing-point of water becoming larger by three-tenths, and six-hundredths when heated to the temperature of boiling water. An appreciable divergence from this rule occurs when we are dealing with a gas near its point of liquefaction.

Returning to the relative expansions of solids, a few practical applications were briefly considered, such as the fusing of glass about platinum in making apparatus for the analysis of gas, or for passing electric sparks through confined gases. Inequality of expansion is also made use of in the gridiron or compensating pendulum. In this a copper bar is placed side by side with a shorter zinc bar, the lower ends being fastened together; the upper end of the zinc bar carries the bob, and the whole is hung from the upper end of the copper bar. The greater expansion of the shorter zinc bar upwards exactly counterbalances the lesser expansion of the longer copper bar downwards, and the centre of oscillation remains at a constant distance below the point of support, so that the rate of oscillation does not vary with the temperature. So a little rod of zinc pointing inwards and fastened at one end to the circumference of the balance-wheel of a watch, expands inwards as the wheel increases in size in warm weather, and makes the time of vibration constant. The watch becomes a chronometer. A certain quantity of mercury placed in a cylinder is also used, instead of the ordinary bob of a pendulum. The mercury expands more than the metal of which the rod is formed for equal columns; and therefore, by taking unequal columns, equality of expansion may be obtained. A most sensitive thermometer can be formed by availing oneself of the inequality of expansions of mercury and alcohol. A little platinum diving-bell is partly filled with alcohol and placed in mercury, and provided with a slender platinum wire rising above the mercury. The whole floats. When the temperature increases the alcohol expands more than the mercury. Some of the latter is driven out of the bell, and the latter rises; the motion of the exposed end of the platinum wire exhibits the rise.

As a rule, gases expand more than liquids, and liquids more than solids for the same increase of temperature; and so, according to the well-known law of mechanics, we should expect to find the force of expansion of solids greater than that of gases. Accordingly the force exercised by expanding solids is almost irresistible. Iron rods are bent or snapped when their centres are pulled by contracting metals. A semi-solid mass, as of glass, suddenly cooled, becomes brittle. A drop of hot glass, cooled in water, becomes solid and rigid on its outside: then the inside cools and shrinks, so that the whole, when cool, is in a condition of internal strain or unstable equilibrium. Disturbed in one place, the whole crumbles to pieces in its endeavor to assume the proper size due to its temperature. The process of annealing depends upon the so gradual cooling of a soft body that the parts get to their proper distances. The bursting of pipes in winter time proves two things: first, that ice is lighter than water; and second, that ice is almost incompressible. Water frozen in a bomb-shell two inches thick will burst it.

The expansion of liquids by heat furnishes us with a means for measuring temperature. An ounce of mercury immersed in freezing water always has a certain size. In boiling water it always has another and greater size. And at any intermediate temperature, got by mixing together different proportions of freezing and boiling water, the mercury has an intermediate size. Accordingly, by measuring the size of any constant weight of mercury, we can tell what its temperature is. Thermometers are made by inclosing any convenient quantities of mercury or alcohol in glass bulbs, with very narrow stems; so that when the liquid gets warm and expands it may rise a considerable height in the stems. Plunge such a bulb into freezing water, and the mercury shrinks in the stem to a certain point; plunge it into boiling water it rises to a higher mark. The lower mark is sometimes called 0, and the other 100 (C.) or 80 (R.), or the lower is called 32, and the higher 212 (Fah.). Water is at its greatest density at 4° C. If we take a flask full of pure water bearing a narrow stem and cool it from, say 10° C., we find it shrink pretty regularly as it cools till it gets to 4° C. It then expands as it cools, so that at 3° it is of about the same volume (and density) as at 5°, at 2° as to 6°, at 1° as at 7°, and at 0° as at 8°. It then freezes and swells in that act to a very great amount measured by the proportion between the whole volume, and submerged volume of a piece of floating ice. When a pond of water is freezing, the surface water is at 0°, the bottom at 4° C.

Heat travels from point to point in space in three ways: (1), by conduction; (2), by convection; and (3), by emanation or radiation. It moves by conduction when the body which receives the heat does not move as a whole, but allows the heat to travel through it. Heat moves by convection when a hot body moves. It moves by radiation when a hot body gives off heat into empty space, or into some medium which does not intercept it. The gradual heating from end to end of a poker in the fire illustrates the first of these methods, the flight of a red-hot cannon-ball the second, and the roasting of meat or the solar heat the third.

Metals, as a class, conduct heat better than any other class of bodies. Hence, when both are above blood heat, metals feel hotter than wood. When below, they feel colder. So that paper is scorched when heated in contact with wood, but not so easily when in contact with copper. Hence, also, lead may be melted in paper. Amongst the metals, silver and copper are preëminent. That copper conducts heat better than iron is shown by heating rods of the two at the plane of contact, and noting the melting of fragments of wax arranged along the two. The great conducting power of metals is shown by the cooling effect they have upon the mixed gases of a burning body. The metal withdraws so much heat from the gas in its neighborhood that combustion is impossible. The miner's lamp is based upon this principle.

Liquids conduct heat as a class worse than solids. The conducting power of liquids is measured by heating the upper surface of a film of liquid, and noting the expansion of the air in a chamber upon whose upper side the liquid film rests. The more complex the composition of a liquid is, the more opposition does it present to the passage of heat by conduction. Chlorine, iodine, and bromine are especially strong in resisting heat conduction. Water is by far the best conductor amongst non-metallic liquids.

Gases are far worse conductors than liquids, and the imperfect conduction of many solids is due to the gases, generally air, which they inclose in their pores or between their fibres. Clothing thus protects the body from loss of heat in cold weather, and from the scorching heat of the sun in hot weather. A red-hot ball may be carried in the hand if a mass of asbestos, which incloses the air, is interposed. Hydrogen conducts heat far better than other gases, and accordingly cools bodies in contact with it with great rapidity.

——THE novel design of Mr. Bessemer to do away with the sea-sickness, so generally incident upon ocean voyages, is about to be given the test of practice. A vessel embodying his invention is now in course of construction at Hull, in England. It is an iron steamer, 350 feet long, 40 feet broad inside of the paddle boxes, and of 2,774 tons burthen. The aggregate power of her engines is placed at over 4,000 horse-power, driving a double set of paddle-wheels, situated 100 feet apart. The novel feature of the vessel is the saloon, which will be 70 feet long and 30 feet wide, and suspended upon massive pivots at the centre and extremities. The movement of the saloon is controlled by a powerful hydraulic gear, worked by the principal boilers of the vessel. It is designed that this gear shall be worked by an attendant, who will be able to give to the saloon a motion always the reverse of that imparted to the ship by the waves, thus preserving the constant horizontality of the saloon—a result which, it is anticipated, will effectually obviate the (to most travelers) unpleasantness of a sea voyage.

——GOVERNMENT engineers have been for some time past busily engaged upon the task of removing the obstructions to the navigation of the Red river. The obstruction to the river, as is generally well-known, consists of an immense accumulation of drift-wood, which is generally spoken of as the "Red River raft." To secure the removal of this obstruction the government has repeatedly spent much time and money in vain. The operations at present conducted are far more systematically planned, and bid fair to be ultimately successful in freeing the river channel. The latest accounts from the scene of operations report that four miles of the raft have already been removed, clearing a much greater distance of the river, and that but three miles of the raft yet remained to be removed.

——The curious prejudices which workingmen are unfortunately too generally afflicted with, and which, more perhaps than the conservatism of employers, retard progress in the arts and manufactures, make their appearance in remarkable form. Several such instances which have lately been recorded are worthy of note as illustrating the force of tradition even in industrial arts, necessarily subject to progressive changes. Speaking of an American planing machine, reproduced in England by an English house, a London contemporary comments as follows: "In the American machine the position of the pulley-shaft *places the driving belt within convenient reach of the operator;* and, its axis being parallel with the line of motion of the latter, these machines may be placed parallel to lathes, and thus economize space and permit of a better arrangement of the workshop." In the English reproduction of this machine, it is stated, that it has the pulleys arranged at right angles, to the position given to them by the American makers; and not only this, but on the opposite side of the machine, entirely out of reach of the workman. The reason assigned for this unaccountable change was that their workmen were used to having pulleys put in that position. Here, then, is a step backwards—a clearly demonstrated advantage in the American invention set aside and ignored to satisfy the unthinking prejudice of the so-called "practical workman." Another instance is equally noteworthy. In some quarters of England the Danks puddling furnaces are watched with no friendly eye. After several attempts, it has been found impracticable to employ men accustomed to the old style of work in tending the new furnaces. Not only have the men to learn a new business, but to unlearn an old one. It has at last been discovered that the conversion of old puddlers into new ones is impracticable. Intelligent mechanics, who know nothing of iron working, are found far easier to train to the Danks furnaces than men who have been working for years, and it has been found expedient to dismiss the old hands and train up fresh ones for the work.

——Some time ago, it will be remembered, the cable between Punta Rosa and Key West repeatedly failed; and, after careful examination, it was determined that the injuries were to be ascribed to the loggerhead turtles so abundant in those waters. In many places the cable presented the appearance of having been bitten through, and in others of having been crushed from both sides, until it had become so much flattened as to destroy, or seriously impair its conductivity. The only resource left for the company was to substitute their cable for one much stronger. This item is curious as indicating to what unforeseen and unprovided-for dangers an ocean cable may be subjected; but a recent accident to the Persian Gulf cable is even more curious. This cable suddenly failed on the evening of October 4th. After considerable work the fault was found, and the cable successfully grappled with, about 118 miles from shore. On winding up the cable, unusual resistance was experienced, as though it were foul of rocks; but, after persevering for some time, the body of an immense whale, entangled in the cable, was brought to the surface, when it was found to be firmly secured by two and a half turns of the cable immediately above the tail. Apparently the whale was, at the time of his entanglement, using the cable to free himself from parasites, &c.; and the cable, hanging in a deep loop over a submarine precipice, he probably with a stroke of his tail succeeded in making the twist which so firmly held him. This is certainly the most remarkable accident which has yet befallen a cable, though others quite odd have happened, namely, the piercing of the Singapore cable by the lance of a sword fish, and the breaking of the cable in the Yar, Isle of Wight, by the carcass of a bullock.

——Prof. Boettger makes the statement that a jet of coal gas may be ignited in the following manner: The gas is to be permitted to issue from the orifice of a finely drawn out glass tube, and to strike against a few grains of finely powdered dust—dry permanganate of potassa—which is moistened with concentrated sulphuric acid. The gas ignites thereupon, it is said, instantly.——From the Scientific American we learn that the recent attempt of the Great Eastern to lift and repair the Atlantic cable of 1868 has failed, owing to stormy weather, and the great ship has returned to England. The work is postponed for some months. The fault has been located at a point not far eastward of the banks of Newfoundland. The cable was successfully grappled and lifted several times. A portion of the original cable, that of 1858, was brought up during the grappling operation, and found to be in a fair state of preservation.

——BEFORE the chemical section of the British Association for the Advancement of Science, Mr. W. J. Russel delivered an excellent address upon the coloring matter of madder, in which he describes in detail the various steps made in perfecting to commercial success, the discovery of Graebe and Liebermann, namely, the artificial production of the alizarine, the coloring principle of the madder root. From his statements it appears almost certain that the industry of growing the madder will shortly be extinguished altogether, and the lands and labor now devoted almost exclusively to its cultivation in many parts of Germany and France turned into other channels of production. Mr. Russel closes his remarks as follows: "The alizarine mud, as I have called it, containing but 10 per cent. of dry alizarine, is equal in dyeing power to about eight times its weight of the best madder, and is, moreover, the pure substance required for the dyeing, in place of a complicated mixture (the natural madder) containing certain constituents which have a positively injurious effect on the colors produced. * * * * The demand and supply of artificial alizarine are increasing at a most rapid rate, and yet the manufacture of it seems hardly to have commenced. The value of madder has much decreased; and in fact, judging by what occurred in the year of revolution and commercial depression, (1848,) when the price of madder fell for a time to a point at which it was considered it would no longer remunerate the growers to produce it, that point has now again been reached, but certainly from very different reasons. Last year artificial alizarine, equal in value to about one-fourth of the madder imported into England, was manufactured in this country. This year the amount will be much greater. Thus is growing up a great industry, which, far and wide, must exercise most important effects. Old and cumbrous processes must give way to better, cheaper, newer ones; and lastly, thousands of acres of lands in different parts of the world will be relieved from the necessity of growing madder, and be ready to receive some new crop."

——TIMBER which has been immersed for some time in sea-water before being sawed in the mill, is, according to a recent showing, better, harder, and much more durable than if immersed in fresh water; and, in Holland, where the art of ship-building has long been cultivated, this fact is well known and practically utilized. Further, it is stated, that wooden piles, driven in the sand of salt marshes, last for an unlimited time. External causes of decay, such as dampness, may be rendered inoperative by the painting of the wood, but dry-rot takes place independently of the presence of paints, and for this evil salt seems to be an effectual remedy. It appears that, even after the dry-rot has made its appearance, immersion in salt water effectually checks its progress and preserves the remainder of the wood. In the salt mines of Hungary and Poland the galleries are supported by pillars of wood, which have lasted for ages, in consequence, it is said, of having become impregnated with the salt; while pillars of brick and stone, used for the same purpose, crumble away in a comparatively short time by the decay of their mortar.

——AT the Atlantic works, in Boston, an experimental tug-boat is in course of construction which is to be propelled by an Ellis bi-sulphide of carbon engine of from 150 to 175 horse-power. The principle of operation and the novelty of this engine reside in the employment of certain arrangements by which it is rendered possible to utilize the heat contained in the exhaust steam for the purpose of generating additional power. This is accomplished by causing the exhaust steam to generate vapor of a liquid, (in this case bi-sulphide of carbon,) which boils at a much lower temperature than water. The expansive force of this vapor, which represents so much additional gain in power, is thereupon utilized through the engine by suitable mechanism. Engines constructed upon this principle are said to operate without requiring special attention, and to show very economical results.

——CHEMICALLY pure iron is said to have been produced by a Russian chemist through means of the galvanic battery. During the process a large quantity of hydrogen was disengaged from the ordinary iron used. The pure metal is described as silver-white in color, very malleable and ductile, and so soft as to be readily cut with a pair of scissors. It is very different from the iron which has heretofore been supposed to be pure. It oxidizes very readily, decomposing water with the evolution of hydrogen.

——Some time ago, M. Meusel announced to the German Chemical Society of Berlin the discovery of two new double iodides of mercury, silver and copper, which were of especial interest in virtue of the property of changing color upon the application of heat. The first of these new compounds is prepared by adding a solution of silver nitrate to one of mercuric iodide in potassium iodide, and is of a bright lemon yellow color, changing under the influence of heat below 212° to a rich orange, and regaining its original tint when cooled. The second is prepared by adding to a warm solution of mercuric iodide in potassium iodide, first, copper sulphate, and then sulphurous acid. Its color is carmine, becoming black, however, at a temperature of 158° Fah., but restored on cooling. When mixed with gum water and applied to paper, these bodies exhibit their color changes in a most striking manner. Especially interesting, however, is the fact that Profs. Barker and Mayer have suggested and patented the application of the carmine compound to the bearing portions of machinery in motion, which are frequently difficult of access, to determine whether they are heating. An inspection of the paint would determine the fact without the necessity of actual examination. It would be interesting to learn whether this suggestion has ever been practically applied.

——According to M. Offret, it is found that with bat-wing gas-burners, though the size of the flame diminishes with the amount of gas consumed, it is not in equal ratio. The cost of a large flame for each candle-power per hour may be, for instance, 0.42 centimes, while with a small one it will be 0.897 centimes. Or, again, the light of a large flame may be equivalent to fifteen candles, while that of two small ones together will be 7.4 candles. The cause of this is attributed to the complete combustion of the gas in the blue zone of the flame, which gives little or no light in either case, and has more favorable circumstances for its occurrence, relatively to the size of the flame, in the small than in the large flame. Another more inexplicable phenomenon is, that, with a flat flame, the intensity of its light is the same, whether the edge or the flat of the flame is tested. This points to the absolute transparency of the flame. The use of cylindrical glass chimneys, with round jets, (argand, etc.,) is concluded to be, on the whole, somewhat more economical than with flattened chimneys, after a series of experiments to determine this point.

——M. Giffard, of Paris, proposes an improved method of producing hydrogen gas in large quantities and cheaply. The process, as far as described, consists in passing steam over scraps of red-hot iron; the iron decomposes the steam, is oxidized, and permits the hydrogen thus liberated to escape through a cooled coil, in which the undecomposed steam condenses. When no more gas issues from the coil, the iron is again revivified by passing a stream of carbonic oxide gas over it when at a red heat. This at once robs the iron oxide of its oxygen, reducing it again to metallic iron, while the carbonic oxide is converted to carbonic acid. As soon as the amount of carbonic acid gas escaping from the coil is small in volume the steam is again introduced, the process being thus kept continuous. The inventor claims that in this way he is able to produce 70 cubic feet of hydrogen per minute. Some such plan, by which the cost of production is materially reduced, will be of much service to the advocates of certain modern substitutes for coal gas for heating and lighting purposes.

——Messrs. Morris, Tasker & Co. have lately introduced to the trade a novelty, under the name of vulcanized rubber iron tube, claimed to be far superior to any pipe material yet offered to the public as a conduit for water, hot or cold. It is said to be able to withstand a high temperature without injury, and to resist the corrosive action of sulphuric and muriatic acids and of caustic alkalies. The article can be applied to all the uses to which galvanized iron is now employed, and, it is claimed, with much more satisfactory results.——The difficulty of finding a material suitable for permanently joining brass with steel or iron, on account of the unequal expansion of the two metals, is well known, on which account it may be of service to note that Dr. Dingler recommends the following alloy possessing the properties necessary to insure a permanent adhesion, to wit: Tin, 3 parts; copper, 39½ parts; and zinc, 7½ parts.——The use of glycerine is highly recommended as a preventive of incrustation in steam-boilers. It is claimed that its presence effects an increased solubility of calcic sulphate, forming therewith a soluble compound, and that the precipitates formed are of a gelatinous character, which can readily be removed with the steam, and does not corrode the valves.

MONETARY.

CONGRESS assembled, finds the monetary position of the country having its direct expression to the national representatives in the embarrassed condition of the federal treasury. Financial legislation, whatever may be had, is likely to have its chief character in the relief of the financial bureau of the government. The government, in its necessities, is using the $44,000,000 of retired greenbacks, and has so far employed about $18.000,000, and the issue of the remainder is probable. It seems to be accepted, that, with present resources of the treasury, outgo will be in excess of income, despite of diminished expenditure and all possible limitation of the burden of interest payments. Secretary Richardson looks to a remedy for annual deficit, not temporary relief, and the temper of congress is not in accord with new interest-paying loans. The question of a deficient public revenue, therefore, tends to be a question between more taxes and more currency, and, generally speaking, the treasurer alone is in favor of the former, while of the latter opposite views are held in different localities, according as the community is a debtor or a creditor one, and in the local opinions the representatives generally share.

The house committee of ways and means gives no countenance whatever to the project of 3.65 convertible bonds—they probably being deemed worse than useless to the treasury, with too much of "contraction" to suit the views of "inflationists," and too much "inflation" to suit the views of "contractionists."

——*Sales of Stocks, etc., at New York.*

	Nov. 24.	Dec 1.	Dec. 8.	Dec. 15.	Dec. 22.
U. S. 6's, coupon, 1881	115⅛	116½	118½	119½	118¾
" 5-20's, coupon, 1862	109½	110¾	111½	114¼	112½
" 5-20's, coupon, 1864	110¼	111½	113½	115¼	114
" 5-20's, coupon, 1865, m & n	111	112	113½	116	114½
" 5-20's, coupon, 1865, j & jy	114	116½	117	118⅝	117
" 5-20's, coupon, 1867	114⅜	115½	117⅜	119¼	117¾
" 5-20's, coupon, 1868	114¾	115½	117¼	118¾	117¼
" 10-40's, coupon,	108½	109	110½	112¼	111¼
Pacific 6's, currency	110¼	109	110¼	113	112¼
Tennessee 6's	80¼	....	....	80½	80⅝
" 6's, new	80¼	....	....	80½	80⅝
North Carolina 6's	....	....	....	....	....
" 6's, new	....	....	....	....	....
Missouri 6's	95	....	....	94⅞	....
N. Y. Central and Hudson R. con	89¼	91½	94¾	95⅝	95½
Harlem	112½	114¾	121½	122½	117
Erie	43⅞	46¼	46½	45¼	44
Lake Shore and Michigan Southern	71¾	71⅞	75⅜	76½	74⅜
Wabash	43⅞	47	52½	52¾	....
Cleveland and Pittsburgh	79⅞	80	82	83½	84
Northwestern	47	48½	53¼	55⅝	54¼
" preferred	....	....	....	....	....
Rock Island	91¾	93	96¼	98¼	97¾
Fort Wayne	86	....	88½	89	88⅞
Milwaukee and St. Paul	32¾	35⅝	39⅛	40⅞	39¾
" " preferred	....	....	....	....	....
Ohio and Mississippi	25½	26¼	29¼	30¾	29½

	Nov. 24.	Dec. 1.	Dec. 8.	Dec. 15.	Dec. 22.
New Jersey Central	93	95	97⅞	100⅛	100¾
Western Union Telegraph	64½	67⅝	72½	73⅜	71½
Pacific Mail	30¼	......	39⅛	39¼	36¼
Union Pacific	21¾	26	29⅛	30⅞	29⅞
Adams Express	81	84½	87	92	91
Wells, Fargo & Co. Express	63	64	71	72¾	72
American Merchants Union Express	57	59	58	58	57
United States Express	57	60½	65	68	67
Rate for Money	7	7	6@7	7	5@6

Sales of Stocks, etc., at Philadelphia.

Gold	109⅝	108⅞	109⅜	110¼	110⅜
Sterling Exchange	118	117⅞	120	121½	120⅛
Paris Exchange	4.76	4.78	4.75	4.60¼	4.69½
Lehigh Valley Railroad	58	57¼	57⅞	57¾	58¼
“ “ 6's	96	93	93¼	93	93¾
“ “ 7's, reg	93½	......	93½	94	94½
Lehigh Navigation	28¾	27	27⅞	34¼	40⅞
“ “ 6's, 1884	88	88	......	88	......
“ “ 6's, g ln	87	88½	87½	87½	90¼
“ “ 6's, reg	88	85	......	89	89½
City 6's, no tax	101¼	99	100⅛	101	100⅞
“ tax	97¾	......	94½	95	95¼
Pennsylvania Railroad	45½	44½	44	45¼	46⅜
“ “ 6's, 1 m	98¾	99½	100¼	100	100
“ “ 6's, 2 m	......	96	96⅝	97	......
Pennsylvania 6's, first series	100	100	100	......	......
“ 6's, second series	104¾	104½	106	106½	106
“ 6's, third series	107½	108	108	109	109
Reading Railroad	53	53½	53¾	55⅛	55¼
“ “ 6's, mt	90	92	......	96	96½
“ “ 7's, reg	100	100	101	102	......
Catawissa Railroad	15½	15	15	15⅞	17
“ “ preferred	40	40½	40½	41½	42
North Pennsylvania Railroad	......	......	45	45	46
“ “ “ 6's, mt	96	......	99	99½	99
“ “ “ 7's, mt	97½	96½	97	98	100
“ “ “ 10's, chat	103	101	103	105	105
United N. J. Companies	114	115	115½	115¼	116
Camden and Amboy 6's, mt	92	......	91	91⅝	92
“ “ 6's, 1883	......	......	90	......	......
“ “ 6's, 1889	......	......	85	......	......
West Jersey Railroad 6's	......	......	83	......	......
“ “ 7's	97½	98½	......	100	100
Philadelphia and Erie	17	16	17¼	17	24¾
“ “ 6's	......	......	83	85	87
Allegheny County 5's, coupon	......	78	78	......	......
Schuylkill Navigation	5¾	5¼	5¾	5⅞	6
“ “ preferred	11¾	11¼	11¾	11⅞	12⅛
“ “ 6's, 1882	71	72	73	73	70
Morris Canal	......	......	......	......	......
“ preferred	......	......	117	118	......
“ 6's, 1882	......	80	80	80	80
Little Schuylkill Railroad	44	44½	46¼	47	46⅛
Oil Creek and Allegheny Railroad	14	14	14	14½	19¾
“ “ “ 7's	59¼	......	60	60½	61
Philada., Germ. and Nor. Railroad	82	82	83	84	85
Minehill Railroad	51	50¼	50¾	51½	......
Elmira and Williamsport, preferred	......	......	......	......	......
“ “ 7's	95	95	95	......	96
“ “ 5's	......	50	......	50	50
Northern Central	24	......	24	27½	29
Rate for Money	6	6	6	6	6

NOTING AND COMMENTING.

PRESIDENT MACMAHON, November 17th, sent a message to the assembly of France, saying that it had been decided by himself, and friends of course, that the substantial good of the country imperatively demanded a prolongation of the powers of the executive for at least seven years, and that he deemed it best to indicate guarantees to be received, without which it would be imprudent for him to accept the office. This proposition of the president was submitted to the committee on prolongation, and it was finally agreed by the committee to prolong the president's powers, but to refuse the extraordinary powers demanded. The next day, General Changarnier presented the motion, previously agreed upon by the right, to the assembly, unconditionally prolonging the president's powers. A long and stormy debate followed, and M. Laboulaye, reporter of the prolongation committee, stated that it was impossible for the government and committee to agree upon any terms. The debate was adjourned without division. Upon the debate being resumed, M. Rouher moved that the whole question be referred to a *plebiscite*, and created a new excitement by hinting that it was not impossible that the Bonapartists might be restored to power. This motion was lost by a majority of 411. M. Depyre, a member of the right, finally moved that the powers of the president be prolonged seven years, independently of the adoption of the constitutional bills, which, although opposed by Laboulaye, Grevy, and others, was adopted by a majority of 66. Another motion was then introduced by the right for the appointment of a committee of 30 on constitutional bills, which was also adopted by a majority of 68, and the vexed question settled. The entire cabinet tendered their resignations to President MacMahon, which, after some hesitation, were accepted, and, Novembet 27th, a new cabinet was announced, headed by De Broglie, interior; De Cases, foreign affairs; General Du Barail, war; and Pierre Magne, finance.—The trial of Marshal Bazaine was brought to a close December 10th; the court, after long deliberation, finding him guilty of the charge of the capitulation of Metz and his army in the field without doing all that honor and duty required, and unanimously condemned France's best soldier to be degraded from his rank and to suffer death. After this decision, the court, with like unanimity, signed an appeal for mercy, which was immediately conveyed by the Duc d'Aumale to Presiden MacMahon, who, December 12, announced that the sentence of death was commuted to 20 years' "seclusion," and that the prisoner would be spared the humiliation of a public degradation, though, of course, he would cease to be an officer in the army. The place selected for the "seclusion" of the prisoner is announced to be the island of Ste. Marguerite, in the Mediterranean sea, off Cannes—famous as the place where the Man of the Iron Mask was imprisoned. Bazaine may be regarded as a vicarious immolation, the country imputing to him its own deficiencies. MacMahon has met half-way the probable reversal of the verdict of history.

The troubles between Spain and the United States, growing out of the seizure of the Virginius and execution of a portion of the officers and passengers, is in a fair way of being settled without bloodshed, if nothing new occurs to disturb existing relations. November 30th, a protocol was agreed upon and signed by Admiral Polo and Secretary Fish, by which it was agreed: 1. That the Virginius and the surviving passengers and crew should be immediately given up to the United States. 2. That the flag of the United States should be saluted December 25th, unless Spain should, before that time, satisfy the United States that the Virginius had no right to carry the American flag. 3. If it shall be shown that the Virginius had no right to carry the flag, the United States government is to institute proceedings against the vessel and owners, and Spain guarantees to institute proceedings against any of her authorities who may have violated either law or treaty stipulations. 4. The matter of reclamations for damages is referred for future consideration. Spain has since shown a disposition to carry out the provisions of the protocol in good faith, though it is evidently very distasteful to the Cuban volunteers. The Virginius left Havana December 12, escorted by a Spanish war vessel, *en route* for Bahia Honda, there to be delivered to the United States; and orders have been given to transfer all the remainder of the crew and passengerss to a United States vessel at Santiago de Cuba on the 15th, with strong probabilities of the orders being carried out, in spite of local opposition.—The insurgents in Cartagena, Spain, continue to make a stubborn defence of the city, although apparently working under the most adverse circumstances. A plot was discovered, November 22d, among the prominent insurgent officers to deliver the city up to the government, but was foiled, all the leaders, except Galves, being arrested and placed in confinement. November 25th, the North German squadron formed a line of battle, and demanded the restoration of 2,500 pesetas, which had been extorted by the insurgents from the German residents of the city. The money was paid, and having thus got rid of two sources of annoyance, the insurgents again turned their attention to the government forces, which seem to have kept up a steady bombardment meanwhile, and so far have succeeded in keeping them at bay. Don Alfonso has been appointed generalissimo of the Carlist forces, but his command appears rather inactive.—The ministerial crisis which at one time threatened to unseat Castelar is reported past—that statesman having succeeded in effecting a reconciliation with Señor Salmeron.

The parliament of Great Britain meets January 5. The elections which have been held resulted almost uniformly in favor of the conservatives, and evidences are not wanting that Mr. Gladstone is losing his popularity, and may be compelled to resign at no distant day. Meanwhile, those in favor of home rule in Ireland are making demonstrations of considerable magnitude.—Advices from the Cape coast say that General Wolseley had attacked the Ashantees, who were retiring from the vicinity of Mampon, and, after an engagement lasting several hours, the Ashantees continued their retreat, and the British forces returned to Dunquah. General Wolseley is reported to complain of the utter inefficiency of the native auxilaries, and says that their tardiness and cowardice have placed him in a very humiliating position. Two hundred British troops have been sent to his assistance.—London has been enjoying the national luxury of fog, to that extent that, for three days, navigation of the Thames was almost entirely suspended, and traversing the streets was extremely dangerous. Even in that foggy city nothing equal to it has occurred for many years.

The German government continues to watch France very closely, and lately thought proper to remonstrate against a pastoral letter of the bishop of Nancy ordering prayers for the restoration of Metz and Strasbourg.—Archbishop Lederochowski, for continuing, unlawfully, to institute priests, has received a fresh sentence of 5,400 thalers fine and two years' imprisonment, and ordered to resign his office at a week's notice. The pope has exhorted him to firmness.—Representations have been made by the government to Spain concerning the two vessels captured near Manilla, and it is expected that the decision of the prize court at that place, which has condemned the vessels, will be reversed on appeal to the Madrid court.—The landtag has refused to censure the government for the legislation against the ultramontaine Catholics.

Russia is preparing a fresh expedition against the Turcomans, and also, report says, engaged in investigating the administration of General Kaufmann in Turkistan, and his campaign against Khiva, and finds it very wasteful and corrupt.—An imperial ukase has been issued, drafting 6 men out of each 1,000 in Russia and the Polish provinces into the army; and negotiations, through the Rothschilds, for a new loan of $75,000,000, 5 per cent., in progress.

A Dutch expedition has left Batavia for Acheen, and it is reported that 9,000 troops have succeeded in effecting a landing without molestation.

A consistory is reported as soon to be held at Rome, at which eleven cardinals will be created, and nuncios to Madrid, Lisbon, Vienna, and Paris, will be appointed; *apropos* of which, comes the announcement that the Swiss government has decided to hand the papal nuncio his passports, on account of the pope's last encyclical letter.

——THE first session of the forty-third congress commenced on the first Monday of December. The house promptly organized by the reëlection of Mr. Blaine as speaker, and Mr. McPherson as clerk, they meeting no opposition of weight. The senate consists of 49 republicans, 18 democrats, and 6 liberal republicans. The house, which meets for the first time since the enlarged representation, based upon then census of 1870, consists of 386 members, of whom 193 are republicans, and 93 are democrats. Among the large number of bills introduced, are five or six designed to amend or annul the Bankrupt law.—A bill, appropriately introduced by Mr. Maynard, of Tennessee, passed the house, abolishing the ironclad test oath, and conferring general amnesty for acts committed during the late rebellion.—The secretary of the navy appeared before a committee of congress and explained what had been accomplished in the way of putting the navy upon a more efficient footing. He has expended all the money which had been appropriated for the ordinary expenses, and assumed the responsibility of ordering a large amount of needful work, trusting to congress to ratify his acts. Upon his representations of the absolute necessity of the measure, a bill was passed, authorizing the increase of the naval force from 8,500 to 10,000 men, with a proviso that the increase shall not continue beyond January 1, 1875, and appropriating $4,000,000 for extraordinary expenses of that department.—A lively discussion, which displayed a strong disposition to descend to personalities, took place over Mr. Hale's bill to repeal the salary law of last session, and, as usual, the original bill was so loaded with amendments as to be unrecognizable. The whole matter is at present in an uncertain state, and the final action of congress is entirely a matter of speculation. A noticeable feature was the participation in the debate of the vice-president of the late confederacy, who spoke in opposition to the repeal of the law as unwise and impolitic, rather advocating a further increase.—The postmaster-general's scheme for postal telegraphs does not seem to meet with much favor, and the same may be said of the attempts which have been made to cause a recognition of the Cuban insurgents as belligerents.

——BOSTON, after having imitated some of the other large cities of the country in absorbing all the adjoining villages, proposes to follow their example otherwise, and have a public park. The traditional Boston common and pond no longer satisfy the Hub. It is urged that the site should be purchased immediately, on the score of economy, the rapid increase in the value of real estate in the suburbs warranting that conclusion. The project has assumed so tangible a shape that a plan has been prepared which contemplates a park of about three square miles' area, and located in Brookline, which, it will be remembered, recently, alone among the suburban towns, refused to be annexed, and is now an independent township, entirely surrounded by the city. Perhaps the Bostonians, despairing of getting the territory in any other manner, have taken this mode of surmounting the difficulty.

——THE president judiciously makes a recommendation to congress to appropriate a small sum for the purpose of exploring the Amazon river and its tributaries, with a view of ascertaining the practicability of increasing trade facilities with Bolivia. The present route of trade is through the Peruvian port of Arica, involving a voyage of about 120 days. The new route, if it should prove practicable, is expected to reduce this one-half. It is stated, also, that by the construction of a railway 180 miles in length, the commercial centre of Bolivia, La Paz, can be brought within 30 days of New York.

——THE report of the postmaster-general shows the ordinary revenues of his department for the last fiscal year to have been $22,996,741.57, an increase over the previous year of nearly 5 per cent.; expenditures, $29,084,945.67, an increase of about 9 per cent.

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THE ARTIFICIAL PRODUCTION OF COLD.

THAT affection of matter styled heat, which was formerly believed to be due to a peculiar fluid existing in the pores or spaces between the atoms of matter, is now, in accordance with a more advanced stage of scientific thought, known to be caused by the motions of the atoms themselves. The possibility of this motion must be admitted, when it is shown that the atoms or molecules are not in actual contact, for then any disturbance of the forces that keep them apart must be attended by a movement about their position of equilibrium.

If we would obtain a clear conception of the atomic structure of bodies, we must picture to ourselves the atoms bathed in an atmosphere of highly attenuated matter, termed ether. Nowhere are these atoms in contact, the distance between them being great in comparison with their size. Moreover, this distance is by no means constant, since they are continually advancing towards and receding from each other in regularly recurring motions; sometimes each atom moving independently of the others, and sometimes in groups of two or three separate atoms, termed molecules.

When any motion is imparted to either the atoms or the molecules, they must, in virtue of their inertia, continue in motion until stopped by some opposing force. Since we may ordinarily consider the molecular forces of attraction and repulsion as in equilibrium, the force to oppose the momentum of the atoms is to be sought in the resistance offered to their movement by the surrounding ether. Heat in the body is caused by the motion of its particles; outside the body by the motion of the surrounding ether, and the motion can only be given to this ether by a partial loss of the motion of the body.

So far, then, as the swing of the particles produced by a given amount of force is concerned, the motion must soon cease entirely from being transferred either to the surrounding bodies or the ether that pervades space. The atoms would then come into absolute rest, and so continue until they received fresh accessions of force. A condition of absolute molecular rest is not, however, a physical possibility. The immense radiation from the sun and the fixed stars, together with the feeble sources found in varieties of mechanical or chemical force, are continually preventing the molecular motion from dying out. If, now, heat be motion, then will this comparative absence of motion be cold. It is purposed in the present article to explain how this reduction of molecular motion can be effected, to point out the causes that tend to produce a reduction of temperature, and to show how this reduction may be utilized.

At the outset, it is well to disabuse the mind of any belief in heat or cold as separate entities: they are relative terms, and differ only in quantity. A body is warm when compared with one cooler than itself, but cool when compared with a warmer one. Heat is motion; intense heat, rapid motion; moderate heat, moderate motion; cold, very slow motion; absolute cold—that is, the greatest cold possible—absolute freedom from motion. Both heat and cold, then, are terms expressive of the condition produced in matter by differences in the rapidity of the motion of its ultimate atoms. When a body becomes heated, we must regard it as having gained much additional motion; when it becomes cooled, we must suppose so much motion lost. To cause a body to become cold, we must cause it to lose part of its motion. Let us, then, inquire as to the different ways in which the motion may be lost, or the temperature lowered.

The reduction of temperature may be effected in three ways: 1. The body may radiate its heat into space, and so become cold; that is, it may impart its motion to the ether that pervades all space. 2. It may share its motion with a neighboring body that moves less rapidly than it does; or, (3), it may oppose its motion to the molecular force of attraction, and thus come into equilibrium.

The reduction of temperature produced by radiation into space is most observable at night, when the sky is free from clouds, since the imparted motion to the ether is greater than that which the body obtains from the fixed stars, or neighboring terrestrial objects. In many parts of the East Indies, water exposed in shallow pans, on clear nights, is frozen by the cold developed by the heat lost by radiation, together with that expended in producing evaporation.

No matter what the temperature of a body is, it is continually losing its heat by radiation into space. The rapidity with which this loss is accomplished depends on the temperature. The hotter the body, the greater is the intensity of the heat it radiates; hence, the greater the rapidity with which it cools. If, then, a hot body be placed in the neighborhood of others cooler than itself, it gives them more heat than it receives, and by thus sharing its motion with them, becomes at last of the same temperature. The transferrence of motion does not, however, cease when this is attained. Each continues giving its motion to the other, the temperature becoming less and less, from the motion expended in moving the intervening ether.

An experiment, first tried in the sixteenth century by a member of the Florentine academy, appears, as it was then believed to do, to prove the existence of cold as a thing separate from heat. A parabolic mirror was placed so that the sun's rays were collected at its focus, and their heat measured by a thermometer placed at the same point. The mirror was next turned towards the clear sky, and instantly the mercury in the thermometer fell, as if it were placed in a focus of cold, as indeed it was, though not in the sense then supposed; for the heat from the thermometer was thrown off into space, while the very low heat-rays from the clear sky formed in reality at the bulb of the thermometer a focus of heat of such low intensity as to be, by contrast, a real focus of cold. The same thing is noticed in the neighborhood of an iceberg; the air gives its heat to the ice, and the ice its heat to the air—the difference in the temperature of the two making the heat of the ice cold by contrast, and thus making it practically radiate cold. In such case, however, we must regard the principal cause of the reduction of temperature not so much what is given off from the cold body, but the excess of motion lost by the heated one.

It is not actually necessary to take away the molecular motion in order to produce a reduction of the temperature. We may oppose the force that produces the motion to some other force, and thus reduce very considerably its amount. Such a reduction of the amount of molecular motion is attended with the disappearance of a definite quantity of heat, which will again appear as soon as the opposing force is removed. The heat which thus disappears is called latent, to distinguish it from that which produces an increase in the temperature, and which, being apparent to the senses, is called sensible. Nearly all the methods now adopted for the artificial production of cold depend for their efficiency on the possibility of thus locking up a portion of the molecular motion. Before, then, proceeding to the explanation of these processes, let us inquire as to the manner in which this temporary withdrawal of the heat is effected.

Solids, liquids, and gases differ from one another; not from any difference in the size or shape of their atoms or molecules, but simply in the varying distances between them. The minimum separation is found in solids, the maximum in gases, the intermediate in liquids. So far as the force of molecular attraction is concerned, the atoms of all kinds of matter would tend to approach each other until contact was obtained. Opposed to this force is that of molecular repulsion. Whatever be its nature, it is simulated in all respects by the force of heat. Indeed, it is difficult to disbelieve that heat and molecular repulsion are but different modes of action of the same force, since they are undoubtedly convertible—a given quantity of either producing a definite amount of the other. Now, whenever the force of heat is acting to produce a greater separation of the atoms of a body than that which previously existed, that heat becomes latent, and remains so as long as the particles are kept apart. Moreover, whenever a body is heated, an increase in its volume is produced at the same time that its temperature is raised. It is, then, apparently impossible to pass any heat into a body, which is in a condition to admit of expansion, without a portion of the heat becoming latent.

During the passage of a solid into a liquid, a large quantity of heat is thus locked up; a still larger quantity during the passage of a liquid into a gas. Conversely, during the liquefaction of a gas, or the solidification of a liquid, a quantity of heat must be rendered sensible, equal to that previously rendered latent.

The principle that underlies the artificial production of cold will now be readily understood. A finely-powdered salt is thrown into a liquid in which it is readily soluble. It cannot dissolve—that is, pass into the liquid state—until its particles are separated from each other further than they previously were. But for this, heat is requisite; and this heat, unless otherwise supplied, is taken from both the salt and the liquid, and a lowering of the temperature is the result. Or, two solid substances, as ice and snow, are mixed together. The salt takes the water from the ice, thus melting it; the water, in its turn, dissolving the salt. Heat is hence required for the liquefaction of both substances, and therefore the reduction of temperature is consequently great. Such mixtures constitute the ordinary freezing mixtures.

Strictly analogous to the case of the production of cold by the solution or liquefaction of one or more solids, is that caused by the evaporation of a liquid. Here, however, much more heat is rendered latent, and, consequently, greater cold is produced. If ether, ammonia, or alcohol, or any other volatile liquid, be poured on the skin, a decided cold results from the abstraction of the heat requisite to produce the evaporation. If a jet or spray of ether fall on the hand, it may freeze, and so render it quite insensible to pain.

We will now consider some of the ways in which a considerable reduction of temperature is commonly effected in practice. One of the simplest of these, where the operation is not carried on on a large scale, is by the well-known freezing mixtures. Where the object is merely to reduce the temperature of a comparatively small quantity of a substance, such, for instance, as the liquefaction of a gas, the cooling of a chemical compound, or the freezing of a small quantity of water or other liquid, these mixtures are generally the most convenient and expeditious.

One of the simplest, and at the same time the one most commonly employed, is that in which a quantity of powdered ice or snow is mixed with half its weight of common table or rock salt. When well mixed, a temperature of —6° Fah. can be maintained for several hours. This is the mixture ordinarily employed in the freezing of ices and creams, since neither of the ingredients are deleterious to health. In order to obtain, with any freezing mixture, the greatest possible reduction of temperature, it is necessary that the substances of which the mixture is composed, as well as the material whose temperature is to be lowered, be kept in non-conducting vessels, in order that all the heat necessary to produce their liquefaction shall be taken from them, and not from surrounding bodies. It is also necessary that moderately large quantities of the freezing mixtures be employed, since otherwise the resulting reduction of temperature will not be so great. If sal-ammoniac be added to the preceding mixture, the resulting temperature will be —12° Fah. The best proportions are five parts of powdered ice, two of common salt, and one of sal-ammoniac. A still greater reduction is obtained by substituting nitrate of ammonia for the chloride. If the substances are mingled in the proportion of twelve parts of snow, five of salt, and five of nitrate, the resulting temperature will reach —25° Fah.

In general, the degree to which the reduction of temperature is obtained depends upon the rapidity with which the solid is dissolved, and the difference between its capacity for rendering heat latent in the solid state as compared with the liquid state. Water has a very great capacity for heat—greater, indeed, than that of any other common substance. The following experiment will prove the statement. If equal weights of ice and water, at 32° Fah., be placed over the same source of heat, in vessels of exactly the same construction, when the ice has melted, the water will have gained 142° additional heat, or will stand at 174°. Since, however, the same quantity of heat may be supposed to pass into each, it follows that 142° have been rendered latent in converting the ice at 32° into water at 32°.

Various acids that have an attraction for water will take it from ice, and, notwithstanding the heat developed through the act of chemical combination, will still produce a considerable reduction of temperature by the rapidity with which the ice or snow is melted. Thus, when snow is mixed with a little more than half its weight of diluted sulphuric, strong hydro-chloric, or nitrous acids—the liquids having been previously cooled to 32° Fah.—considerable cooling will ensue, the mixture reaching a temperature somewhere in the neighborhood of —28° Fah. A still greater reduction is obtained by mixing with snow rather more than its bulk of crystallized chloride of lime or caustic potash: the temperature then falls as low as —50° Fah.

It is not necessary, however, that ice or snow be one of the ingredients. If any rapidly soluble salt be mixed with water or an acid, a considerable reduction of temperature will result. The nitrates of potash and ammonia, the sulphate, phosphate, and carbonate of soda, and the chloride of lime and ammonium, are among the best for this purpose. By varying the proportions of these substances, and their solvents, reductions of temperature can be obtained as far as —50° Fah. In this extreme case, however, the substances of the freezing mixture with which it was obtained were first rendered cold by some of the less powerful agents.

We have already called attention to the fact that a much greater quantity of heat disappears, or is rendered latent, during the conversion of a liquid into a gas, than during that of a solid into a liquid. Consequently, freezing mixtures that depend for their efficiency on the rapid vaporization of a liquid, will produce a proportionally greater decrease of temperature than in the cases we have just considered. In this respect, also, water takes the lead of all ordinary substances. In round numbers, 1,000 degrees of heat are rendered latent during the conversion of water at 212° Fah. into steam at 212° Fah., as the following simple experiment will show. A vessel containing water at the temperature of melting ice is placed over a steady source of heat, and the time required to bring it to the boiling point carefully noted. If, now, the heating be continued, and the entire quantity of water passed off as steam, it will require about five and a half times as long to cause the water at 212° to be converted into steam at 212°, as it did to cause the water to pass through the 180° between 32° and 212°. Equal quantities of heat passing in at all times, the amount rendered latent in converting the water into steam is five and a half times 180°, or 990°. Conversely, the heat given off during the condensation of the steam from a pound of water is sufficient to raise the temperature of ten pounds of water 990°. Hence, as before, ten times 99° = 990°, the amount of latent heat rendered sensible—a quantity which may be taken in round numbers as 1,000° Fah.

It is a well-known fact that water will evaporate at temperatures very far below the boiling point—indeed, even at and below the freezing point. The question then at once suggests itself as to whether the quantity of heat rendered latent during the conversion of water into vapor at 212° Fah. is greater or less than at some lower temperature, say 60° Fah. In general, it may be stated that the amount of heat rendered latent is less, in proportion, as the temperature of the vaporizing liquid is greater. The total heat of any vapor is clearly equal to the sum of the sensible and latent heat. Thus the total heat of steam is equal to the sensible heat, 212°, plus the latent heat, 1,000°, or 1,212°. For rough calculations, the latent heat of any vapor is obtained by subtracting its temperature from the constant, 1,212°. Thus the latent heat of superheated steam at, say 312°, is 900° Fah., while that of vapor of water at 60° is 1,152°. The proportionally large quantity of latent heat will explain the cause of the rapid lowering of the temperature of a mass of water that is so circumstanced as to cause its rapid evaporation.

Under ordinary circumstances, the force that prevents the rapid evaporation of a volatile liquid is the pressure of the atmosphere. The particles of a liquid are ordinarily supposed to be at such a distance apart that the molecular forces of attraction and repulsion exactly balance each other; but, in this case, the force of attraction is aided in keeping the particles at this distance by the weight of the superincumbent atmosphere. As soon, therefore, as this is removed, a rapid vaporization is the result. In accordance with this principle we find that all volatile liquids volatilize instantly in a vacuum. If, however, the vacuous space is limited, the vapor of the liquid soon creates an atmosphere of its own, which presses on the surface with a tension varying with each liquid. The rapidity of evaporation would depend, therefore, on the quantity of the vapor already present in the space, and on the degree of the vacuum produced. Any process, then, for the production of cold, that depends for its efficiency on the evaporation of a liquid, must provide for the rapid removal of the air and the volatilized liquid from its surface.

The removal of the air is easily effected by means of an air-pump. The vapor can be carried off by the same means, or it can be removed by the chemical attraction existing between it and some liquid body. When the volatile liquid employed is other than water, it is necessary to save the condensed vapor for repeated use, and so render the process continuous. This is readily accomplished: the vapor is both removed and condensed by mechanical means, by the employment of some form of condensing pump. In either case, the heat developed during the liquefaction of the vapor by absorption or condensation, is removed by a stream of cool water, or other means. All forms of ice machines of practical value, so far invented, depend for their efficiency on principles identical or analogous to those we have just described.

One of the earliest and simplest of these methods is due to Leslie, famous in the scientific world for his researches on radiant heat. A vessel containing water is supported on some non-conducting substance over a dish of strong sulphuric acid, placed on the plate of an air-pump, and covered by a glass bell. On removing the air, a rapid evaporation of the water ensues, the vapor being absorbed by the sulphuric acid as rapidly as generated, and the water soon freezes. An application of this principle has recently been patented, for the manufacture of ice on a large scale, with, it is claimed, excellent results. The possibility of the contamination of the water surface with the sulphuric acid is carefully avoided, the vapor being conducted through tubes to a separate chamber containing the acid.

Another of the earlier methods is due to Wollaston, in which a liquid is frozen by its own rapid evaporation, without the intervention of any other absorbing liquid. The apparatus has been termed the cryophorous, or frost-bearer. It consists of a tube bent in the form of the letter J, furnished at each end with a small bulb. All the air has been thoroughly driven out by the boiling of the water, and the tube hermetically sealed. In the vacuum thereby created a portion of the water instantly evaporates, but soon the tension of the generated vapor prevents any further evaporation. If all the water be now caused to occupy one of the bulbs, and the empty end be immersed in cold water, or, preferably, in some simple freezing mixture, the vapor is condensed as rapidly as it is generated, and the water in the upper bulb soon freezes.

Wollaston's cryophorous, which at first seems utterly incapable of any practical application, has been modified by a Frenchman named Carré, who exhibited his improved ice machine in Paris in 1867. By Carré's machine, which is among the simplest and most efficient of any yet constructed, results have been obtained that appear to render the cheap artificial production of ice a commercial possibility. In the Carré machine the water is replaced by a strong solution of aqua ammonia—that is, of water containing a large quantity of ammoniacal gas. The essential portions of the apparatus consist of two vessels that are connected by means of a tube, and firmly braced together. These vessels are called respectively the boiler and the freezer. The boiler is upright, and slightly conical in shape. It is made of strong galvanized iron plate, of a thickness to enable it to resist a pressure of about seven atmospheres. The freezer is made of two concentric cylinders of strong iron plate, with a large space left hollow at the centre of the inner cylinder, where the vessel containing the water to be frozen is placed. The annular space between the two cylinders is in communication with the solution of ammonia in the boiler. The capacity of the boiler is, say two gallons. To produce ice with this apparatus, two operations are necessary. It is three-fourths filled with strong aqua ammonia through a screw tubular, which is then firmly closed. A little receptacle for oil in the top of the boiler admits of the introduction of a thermometer for regulating the temperature. The boiler is now placed on a furnace, and the temperature raised to about 260° Fah.; the freezer at the same time being immersed in a vessel of cold water. The heat liberates the ammoniacal gas from the water, and drives it into the freezer, where, by the pressure and cold produced by the water, it is condensed into a liquid. At the same time, the heat developed during the condensation is removed by the water. In a little more than one hour all the ammonia has been driven from the boiler and condensed in the freezer. And now the second step in the operation is commenced. The water to be frozen is placed in a metallic vessel, in the freezer, which is now removed from the water, and supported on some non-conducting substance, and, preferably, wrapped in flannel, or some other coarse cloth. At the same time the boiler is immersed in a vessel of cold water, a partial vacuum being thus created in it by the condensation of the vapor. The condensed ammoniacal gas in the freezer instantly vaporizes, and passes back again towards the boiler, where it is at once absorbed by the water which it still contains. But to thus pass into vapor it must absorb heat. This it takes from the water inside the freezer, which is at last converted into ice. In a machine of the size we have just described, the water in the freezer will be converted into solid ice in a little more than one hour. It will give about four pounds of ice at a cost of half a cent per pound.

Modifications of the Carré machine have been devised, by means of which the operation can be carried on continuously, and large quantities of ice produced at a greatly diminished cost. One recently exhibited claims an annual capacity of 1,300,000 pounds, at an average cost of one-fourth of a cent per pound. Others claim that by suitable means the cost can be diminished to one-eighth of a cent per pound. In all such calculations, however, a very important element is disregarded, viz., the interest on the apparatus and the rental of the premises. The latter, it is true, may be greatly diminished by locating them at some distance from large cities; but here the cost of transportation must be provided for. Still, after introducing all these elements into the calculations, it can be shown that artificial ice can be produced at very cheap rates. Of course, other liquids may replace the ammonia in the Carré process: methyllic ether and ordinary ether have been used with success.

Another machine, which possesses equal, if not greater claims for efficiency and economy of action, than the Carré, is found in one patented by Jellier. The Jellier ice machine is merely a modification of the Carré. In each the reduction of temperature is obtained by the rapid evaporation of ammonia; but, instead of producing the condensation of the ammoniacal vapor by its absorption by water, the same thing is effected by mechanical compression. The ammoniacal gas is first pumped into strong cylinders, and liquefied by pressure, the developed heat being removed by immersion of the cylinders in cold water. The cylinders are then connected by pipes with a contrivance called the congealer. This consists of a strong, square box, divided into numerous compartments by hollow, metallic partitions, which are connected with the pipes attached to the cylinders. The water to be frozen is placed either directly in the compartments, or these are partially filled with strong brine, solution of chloride of calcium, or other liquid that could not be frozen by the cold produced, and the water placed in thin metallic vessels in this solution. A stop-cock is now opened, and the liquefied gas forced into the hollow spaces between the compartments. Hence it expands, thereby reducing the temperature of the water. At the same time a pump removes the vapor as rapidly as it is generated, and carries it to a reservoir, from which it is again forced into the cylinders. The operation is a continuous one; the same gas is used over and over again; the only break is in the time required to remove the blocks of ice, and replace them by fresh vessels containing water.

The inventor has still further modified the apparatus, by means of which he is enabled to apply its refrigerating powers to reduce the temperature of large, crowded rooms, during hot weather—to supply the cool, fresh air, so much needed at times in large hospitals—or for keeping the temperature of a room filled with perishable materials, such as fruits or meats, at such a point as to ensure their preservation. To accomplish this end, the hollow portions of the congealer are replaced by a long coil, or series of coils, of metallic pipes, through which dry air is forced by a fan, or other mechanical contrivance. He claims, by regulating the quantity of liquefied gas passed into the congealer, together with the quantity of air urged through the pipes, to be able to keep the temperature of a large room at any constant point not lower than 32° F. The advantages of such a refrigerator for preserving perishable articles are manifest, since the air can be supplied to the chamber entirely free from moisture, which is not the case when the cooling is effected by the passage of the heated air over ice.

A very important investigation has recently been made respecting the relative rapidity of melting of natural and of artificial ice. A French steamship company, the *Messageries Impériales*, desiring to ascertain the comparative value of different ices in this respect, with a view to employing it in their vessels navigating the Suez canal, instituted a series of comparisons, with the following results: In each case 200 pounds of ice were taken, and the time carefully noted that was required to melt it, care being taken to place each specimen under conditions strictly identical. Selected specimens were obtained from Switzerland, Norway, and Massachusetts, together with the artificial ice produced by Carré's and Jellier's machines. The results, which it appears are quite reliable, prove the superiority of the artificial over the natural ice. The 200 pounds of Swiss ice melted in 107 hours; the Norwegian in 115 hours; the American in 138 hours; while that produced by Jellier's machine required 144 hours.

An entirely independent set of experiments, having in view the comparative cooling effect produced by a Carré machine, and the melting of natural ice, have been made. These results are also in favor of the artificial method. A room containing 3,375 cubic feet of space was raised to a temperature of 80° Fah. by means of a stationary steam heater. A blower forced air into the room through a set of coils in the refrigerator of a Carré machine, and the time required to produce a given reduction of temperature carefully noted. In seven minutes the temperature of the air was reduced to 46° Fah.; or, more correctly speaking, a sufficient quantity of cold air was forced into the room to produce, by its mingling, this temperature. In three-quarters of an hour the air in the room stood at 32°. The steam-power employed to force the air into the room was less than five horse-power. The next day the room was reheated to the same temperature, viz., 80°, and the temperature lowered by the melting of Portland ice, of which 1,054 pounds were employed. Two hours and a quarter were required to reduce the temperature to 46° Fah., and at this time but 754 pounds of ice remained. Comment is unnecessary.

We have selected the Carré and Jellier machines for description as being the best examples of the two distinct, though somewhat analogous, operations resorted to for a reduction of temperature. There is quite a number of other machines, but they all operate on principles that are similar, if not strictly identical with the two we have described. Those, for example, of Reece and Mort resemble, in general, that of Carré, while that of Siebe bears a resemblance to Jellier's.

The public attention, however, has been quite recently attracted to a very remarkable machine for artificial refrigeration, that operates on a new principle, or, at least, a new modification of the old principle. This machine, which was originally patented in Germany, was repatented in the United States in March, 1870. It is known from the name of its inventor as the Windhausen ice and refrigerating machine. Briefly expressed, its operation is as follows: Liquids are entirely replaced by ordinary air. A powerful steam engine forces the atmospheric air into a compression cylinder: the capacity of the stroke is such that 70 cubic feet of air are compressed for every revolution of the engine. If the engine makes 36 revolutions per minute, this will compress 150,000 cubic feet per hour. A compression is obtained sufficient to cause every two and a half volumes to occupy one volume. Of course, much heat is thereby developed; generally about 125° above the temperature of the air on entering. This heat is gradually abstracted by allowing the condensed air to pass slowly through the condensers, by a series of pipes. The condensers have a constant stream of cold water running through them. By this means, when the air has reached a cylinder, where the expansion occurs under a gradually diminishing pressure, it has been cooled down to its former temperature. From this cylinder, which is worked by the same stroke of the engine that condenses the air, the cooled air rushes out into the space to be cooled with considerable velocity, its temperature being about —35° Fah. The apparatus is capable of giving a temperature of —54° Fah. No figures are as yet given as to the comparative cost of the ice produced by this machine and that produced by the machine of Carré or Jellier, but we believe that the comparison would be very favorable.

By employing very strong cylinders, and conducting the compressed air through freezing mixtures, very low temperatures may be obtained. And thus it seems as if this machine was about to supply a need long felt in the scientific world, viz., a means of obtaining very great reductions of temperature for the purposes of experimental investigations on the behavior of the non-coexcible gases in the presence of extreme cold.

As to the question whether artificial ice can ever compete in cheapness with the natural product, we believe the answer to be in the affirmative. The recent ice monopolies seem to have directed the inventive genius of the country in this way, and the practical solution of the question is becoming plainer and plainer.

FANCY AND FOREIGN WOODS.

MODERN cabinet-making is indebted for many of its most beautiful articles to certain new foreign woods, and the discovery of the veneering process by Brunel, whereby the expense was diminished to about one-tenth that of ancient times, for the material alone. In the furniture of the eighteenth and previous centuries, massiveness was characteristic, and, as casters had not been invented, the moving of even chairs required a serious effort. With their ponderous high backs, immense seats, and thick legs—often carved to claws grasping balls in a manner very suggestive of inertia—they seemed to plant themselves against walls, as if intending to stay there.

All this is now changed, and what remain are but curiosities. Even where there is an appearance of massiveness, the weight is generally diminished by the top, bottom, shelves, drawers, slats, and inside of seats being of lighter and more common woods. A much better and more widely diffused taste for handsome forms has also been developed—the elegant carvings of a former age have been united with modern lightness and better designs, and, through the aid of machinery, these improvements are now enjoyed by people in most moderate circumstances, which was not the case forty years ago. Fashion has changed mahogany for walnut—sometimes oiled and sometimes varnished; but an increased taste has been developed for the newer foreign woods—the greater cheapness, and facility of working them by steam machinery, allowing more general use.

We desire to speak of some of these interesting and important woods, and it is but right to commence with mahogany, (*Swietenia Mahogani*, of Linnæus,) though it has been, to a large extent, superseded; for no foreign wood can be obtained in such quantity, and the beauty of some descriptions of it is very great. It is found principally in Africa, the West Indies, Honduras, Guiana, and Brazil—the finest coming from Honduras. It is more easily cut than most other foreign woods, is not attacked by worms, holds glue with great tenacity, and some qualities are most beautifully veined and curled. Forty years ago, choice lots of this wood brought great prices. The Messrs. Broadwood, piano-forte makers, of England, paid in one case £3,000 for three logs of it, each 15 feet long and 38 inches square. Now that it is much less used for furniture and doors, and oak is becoming yearly more scarce, there is a new use to which it might be put in ship-building. When the fact is considered that in Central America vast forests of it exist along and near the line of the Panama railroad, it is singular that it has not yet been more adopted for this purpose. The cost, previous to the formation of this railroad, and through the former great demand, was much enhanced by the additional fact that most of the trees on the accessible rivers, and near the sea coast, were cut down, necessitating laborious transportation from the interior. These two obstacles being now much diminished, there is no reason against its adoption for nautical use. It is said to be more stiff, less liable to dry-rot, and is more buoyant than most woods used for ship-building. There are records of some mahogany ships which have shown great durability, and this quality will greatly compensate for some increased cost at the first. As masts for large ships must frequently be formed of many pieces put together, this wood, from the superior tenacity with which it holds to glue, and its great strength, would be very suitable for this special purpose. There is a cement or glue used for masts, so strong that the fibres of the wood will part anywhere rather than at the joints, and it is not affected by the weather. A few years ago, there still remained an unfair discrimination against mahogany ships, at the great Lloyds' office in London—they being rated as A No. 1 for ten years only, against twelve years for an oak vessel. This was a very material cost in insuring.

Rosewood is a term indefinitely applied to several species of *Mimosa*, known as *Jacaranda*. One superior variety (*Amyris Balsamifera*) comes from the East Indies, the Canary islands, and Africa, but the chief supply of this wood is from Brazil. The name is derived from its fragrance; and its dark, rich-veined appearance is too well known to need description. The trees that produce it are often of great size, and the average of the logs imported is 22 inches square. It maintains its hold yet on fashion, chiefly for pianos and wardrobes, to which furniture it lends great beauty, from the splendid polish it will receive, and the unchangeableness of its color.

Zebra-wood is from a large forest tree, the logs being often two feet square, and it is imported in considerable quantities into Europe, and sparingly into the United States. It is relatively cheaper than most foreign woods, and is used for large work, such as tables and wardrobes. The color, from which the name is derived, is brown on white, and clouded with black.

Acker-wood is of cinnamon color, and from a large tree. Canary-wood is a golden yellow, as its name imports; and purple-wood, which was introduced only about thirty years ago, is of a deep purple, without veins, and the product of a tropical thorn. It comes in sticks only about four inches thick. These three last-mentioned woods are used mostly in small pieces, for mosaic floors, edging, and table-tops.

Bird's-eye maple, formerly a very fashionable wood, and still in considerable use, is found to some extent in this country. It is of cream color, speckled throughout irregularly with small, round spots, and comes generally in long, narrow strips.

Coromandel-wood, so named from the chief place of production in the west part of India, is, like the zebra and rose wood, of sufficient size for large furniture. It is inferior to the latter in brilliancy and division of colors, having a dingy ground, running into white streaks.

Tulip-wood, some kinds of which are found in this country, (*Liriodendron Tulipifera*, of Linnæus,) comes, when imported, in pieces only about five or six inches in diameter, and four feet in length. It is very hard, of a clouded yellow color, and is used principally for cabinets, boxes, small stands, and work tables.

Beef-wood, for which we can find no more tasteful title, nor discover its applicability, except from color, is intensely hard, and is mostly used for bordering. In color it is a pale red, less striped than mahogany. It is a native of Australia, and comes in logs about 14 feet long by 14 inches square.

Satin-wood—sometimes of a brilliant yellow color like box-wood, but generally more of an orange shade—is from the *Ferolia* and *Guianensis* (Aublet), of Guiana, and the *Chloroxylon Swietenia*, of Ceylon. One very beautiful variety, from St. Domingo, is elegantly mottled. The logs are generally seven or eight feet long, and about two feet square.

Sandal-wood is the heart of the *Santalum Album* and S. *Freycinetianum*, and to obtain it the natives generally bury the logs in the earth for about two months, when the outer portion is destroyed by the white ants, who do not touch the inner part. It is of a light brown color, with brilliant waves of a golden hue, not unlike the finest kinds of Honduras mahogany.

Ebony (*Diospyros Ebenum*, Willdenow,) is an extremely hard wood, and takes a magnificent polish. Some of it, such as the "African cliff," is entirely black, but the most valuable kinds are spotted with white, and some with brown and yellow.

Amboyna-wood, from the Molucca islands, though from a large tree, coming in logs two feet square, is mostly used for smaller cabinet-ware. For some reason it is but little imported, and is about the most expensive of all foreign woods, being worth now, wholesale, $2.50 per pound. It is of various colors, and the stripes and shades are generally narrow.

Snake-wood, used mostly for bordering, and for cabinets and mosaic work, is of a deep red color, with black shades. Hare-wood resembles satin-wood, but the color of its waves is different, and the ground is light brown. Botany Bay oak is a very beautiful wood, being of uniform brown color, with large, dark blotches, not striped.

Calamander-wood, a native of Ceylon, is one of the most elegant of all foreign woods, and it is surprising that, with improved tools, it is not more used. It is so hard, however, and heavy, that formerly it was worked with the greatest difficulty, and only by means of files and rasps, which greatly increased the expense. Its color is of such a remarkable variety that it is hard to describe, being composed of a great admixture of shades—the prevailing one being a fine chocolate, deepening to black, and variegated by fawn and cream colors, and sometimes the richest shades of brown. Occasionally there are clustering mottles and streaks, yet it is never fantastic or gaudy. It takes a beautiful polish, and in the panels of doors has a splendid effect. The tree grows to a large size.

Partridge, leopard, and porcupine woods are very handsome, but rarely imported. They derive their designations from points of resemblance to the animals.

Box-wood (*Buxus Balearica et Sempervivens*) is not unlike canary-wood, but is of paler color, and used entirely for smaller cabinet-ware.

King-wood, from Brazil, is extremely hard, and must be used for strips, mosaic, and general small work, as the pieces are rarely over four feet in length by five inches in diameter. It is of chocolate ground, with black veins, sometimes running into the finest lines; and at other times spreading out into clouds, like rosewood.

Lignum Vitæ, (*Guaiacum Sanctum*, of Linnæus,) found in the West Indies and Honduras, is called the hardest and heaviest of woods. It comes from a tree often five feet in diameter. The felling is a work of great labor and much time. The color is dark olive, varied with reddish-brown; and there is a slight fragrant odor; also a pungent, acrid taste, if held awhile in the mouth. This tree yields also the valuable pharmaceutical gum, Guaiacum.

The woods of the cherry, apricot, apple, wild plum, and pear trees—all of which are close-grained and hard—are now often adopted in combination with foreign woods, with the most pleasing effects, in furniture. Some of them are also largely used for handles of tools.

The roots of most large trees, such as the oak, elm, chestnut, ash, maple, and apple, when sound and carefully cut across into veneers, show the most beautifully twisted and clouded appearance, equal to many of the handsomest foreign woods, and in panels, strips, or mosaic work, form elegant effects. Such veneers require to be thicker than those cut with the grain, and are much more difficult to work and polish, but will well repay all labor put upon them. No better direction could be given to improved mechanical skill, than to render valuable such worthless materials as roots are generally considered, and which are also often so much in the way of the agriculturalist.

There is a field of the most profitable and lasting enterprise now open for any company of sufficient capital which would originate a proper system of felling and transporting the valuable foreign woods to this country and Europe, from India, Ceylon, Australia, the Polynesian islands, Mauritius, Madagascar, Africa, Brazil, Guiana, Honduras, and the West Indies.

The great difficulties undoubtedly are the deadly climates of some of those countries, necessitating the use of the clumsy labor of the natives; and the transportation from the interior to the coast, even when the best appliances could be brought to bear upon it. But, wherever the Anglo-Saxon race goes, there railroads soon abound, and are now to be found in India, Australia, New Zealand, and even in the small island of Mauritius; so that there is, every year, less excuse for neglecting so much as has been done, the magnificent bounty which Nature has spread forth in the torrid regions for those who will have the energy properly to avail themselves of such advantages.*

There are some of the ordinary American and European woods which admit of a fine polish, and, by recent improvements in chemistry and dyeing, can be permanently colored, so as to imitate the best foreign woods. This latter, and the cutting of veneers from roots of our native trees, as already mentioned, are branches of the lumber business which have not yet been developed, or pursued to the extent they deserve. These await some enterprising individuals, who, by establishing them on a firm basis, will confer a benefit on the community, whilst reaping a large advantage themselves.

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* By quotations in November, 1873, the following were the wholesale prices, in New York, of some of the more important foreign woods: Mahogany, 16@25c. per pound; Hungarian ash, 18@20c. per pound; figured satin wood, 12@15c. per pound; tulip-wood, 15c. per pound; French burred walnut, 40@50c. per pound; rosewood, 5@10c. per pound; bird's-eye maple, 8@10c. per pound; amboyna-wood, $2.50 per pound.

MIND, VOICE, AND INVOLUNTARY GESTURE.*

IT would be erroneous to confine the investigations of natural science to those phenomena which constitute the realm of sensual perception; its scope is far wider, and embraces everything that comes within man's perception, be it sensual or spiritual. Its greatest charm consists in fact in the light it throws upon that mysterious bond which unites the visible with the invisible, matter and mind, and upon the harmony in the laws which govern both; for in this light we recognize Nature as the expression of a power superior to the individual mind; her laws revealed to us in the forms and in the development of the outer world as the laws of our own thoughts; the spirit which animates her as kindred to our own.

It is from this point of view that the subject of the following discussion was suggested to the writer, who endeavored to trace this undeniable connection between the spiritual and physical world in some of its most striking manifestations, as revealed to us in the harmony between man's internal emotions and their outward reflections in glance, voice, and muscular motion.

There is a deep-rooted sympathy not only between man and man, but between man and Nature—for she, too, is animated by the breath of life. By particular organs she affects our soul, and fills it with impressions of pleasure or displeasure. There is no direct effect produced by the mind—its mediators are the senses. Even the mysterious attraction that draws soul to soul is traceable to sensual impressions, for the sensual form expresses the essence and life of the soul; therefore men have tried at all times from the former to cast a glance into the innermost life of the mind, to estimate man's entire mental substance from the structure of his skull, the expression of his countenance, and his gestures. But man is a totality in which every single part manifests its activity only in connection with all the other parts, and which for this very reason cannot be fully understood from one single part. And yet there is no mental process that does not manifest itself more or less in all his organs, or find outward expression in all the forms of his body. The hasty step, the sparkling glance, betray the sanguine person; the stooping carriage and uncertainty of his movements, the melancholy one; from the gnashing teeth, the wrinkled forehead, the panting breath, we recognize the emotion of anger; in the dull glance, the half-open mouth, the drooping arms, pain is reflected to us; while the smooth forehead, the radiant eye, the changeful play of facial expression, reveal to us joy and pleasure. In the deep furrows of the forehead we read the imprint of sorrow and satiety of life; in the sharp outlines of the mouth and nose, envy, ridicule, defiance, and malicious joy.

Nothing is so well adapted to determine our judgment of personal character as the human eye—this most active and delicate mediator between man's mind and the outer world. What the sunbeam is for the landscape, that is the glance of the eye for man. It opens before him the world of life, and measures the infinity of space, reveals the forms of everything that is, and awakens the emotions of the mind. It introduces endless treasures into the soul, and reflects them outwardly. It is the torch by the aid of which we penetrate into man's innermost heart when his lips grow silent, or his word tries to deceive us. It reflects the shadows of impure impulse, and the fire of hidden passion, the faintest glimpse of hope, the flash of quick resolution, the clear light of investigating thought. Though silent, it speaks with a voice of earnest command; it punishes and admonishes, comforts and cheers, blesses and curses. It speaks when our emotions find no expression, and when our thought in vain struggles for words.

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* **Translated from the German of Dr. Otto Ule, for the American Exchange and Review.**

The inner life of the eye consists in light, sensation, and motion. It is true the source of light streams from without into our eye, but in the latter only light is produced. As the pain caused by the prick of the needle, so does the sensation of light belong to us. Oscillating waves penetrate to the optic nerve with a velocity of 40,000 geographical miles per second, and are similarly perceived by it as light, as the slower oscillations of the atmosphere are perceived as sound and tone by the auditory nerve. And as the difference of the various tones, so also the variety of colors depends upon the different velocity of these waves. The impression of red is produced upon our optic nerve by a velocity involving 458 trillions, that of violet by one equivalent to 727 trillions of oscillations per second, and between these two extremes lie all the other shades of color. These oscillations are received and perceived by the retina, which cannot be replaced by any other nerve, when destroyed or insensible, as, *e.g.*, in amaurosis. In this nervous complex alone every impression from the outer world produces the sensation of light and color. Every violent shock upon the eye is turned into flying sparks, the electric current into a flash of lightning, and even the pulsation of the excited blood causes alternating currents of sparks. The eyeball, over the background of which the retina extends, with its lens, its transparent cornea, and its light-refracting humours, constitutes only the optical apparatus through which the outer world in all its details can be reflected upon the retina, and without which everything would be perceived as vanishing in an indistinct and confused brightness. The lower animals, whose optic nerve is spread only under a transparent membrane, can therefore distinguish only between dark and light—*i. e.*, separate a sensation of the activity of the retina from a sensation of the latter when in a state of rest.

The beauty of the colors, of their combination and change, is nothing existing outside of us as it might appear, nor are their laws determined by the caprice of fashion and prevailing taste; they originate in the peculiar life of our eye, and are the demands of this ever active sense, which, when fatigued by the irritation produced by a single color, calls for new irritations to give it relief. Only upon the constant change of conditions organic life is founded; also the optic nerve requires constant changes, and creates them when they are not offered to it from without. Even the eye of him who is born blind encompasses all the riches of colors from light to darkness, provided the nerve is not destroyed, though the gate is closed for him through which the outer light enters. His eye, to be sure, does not perceive the brilliancy of the sun and of the stars, nor the variegated butterfly hovering over the many-colored meadow land; it does not see the magic glow of a sunset nor the shades of night spreading over the gradually hushed earth; but it distinguishes between light and darkness, colors, many-hued pictures of fancy. The changes in its own conditions are converted into a mirror of colored bright and dark pictures, for which it certainly never can borrow their colors from without.

Also the healthy eye gratifies instantaneously the inner longing for a reconciliation of colors when it is not gratified from without. For only where the eye, freely gliding over the colored surface, every moment is satiated with the light of one color without being surfeited by it, where it is impressed with a well-defined change of gradual transitions without too harsh contrasts—only then the eye fully enjoys its own life; and he who sees transfers such enjoyment, which is actually nothing but the enjoyment of his own normal organic activity upon the many-colored outer world, in which he recognizes the same struggle and the same reconciliation. Thus beauty in the world of light and of colors is determined by the activity of the optic nerve, and the law of beauty by the law which underlies the activity of our senses.

If sensation renders the eye the rich source of beauty for the soul, so does its motion convert it into a mirror of the mind, an interpreter of sentiments and thoughts. Even the outer muscular surroundings of the eye participate in this emotion. The eyebrows, contracted or raised, smooth or arched; the eyelid lowered or raised, more or less widely opened, produce a variety in the light and shade of the eye upon which the expression of the glance essentially depends. Sparkling light is reflected from the depth of the eye; and the dark surrounding, the projecting edge of its cavity, convert it into awe-inspiring fire. A bright lustre radiates from the moist surface of the cornea, and the free, open eye subdues it into a gentle glimmer. But of quite a different signification is the motion of the eyeball itself, which is suspended in an osseous covering, open in front, and held and moved by six appropriate muscles that are fastened to its perimeter and run backwards, thus giving, by their changing individual or combined contractions, the greatest variety of directions to the axis of the eyeball. By this muscular apparatus we are enabled to combine the sensations of both eyes into one, to let our glances glide from one point to another, to soften or intensify the light sensations by contracting or expanding the pupil. In this possibility of freest motion lies at the same time the charm of manifesting this faculty, the enjoyment of motion itself; and, while enjoying the organic activity of our eye muscles, we transfer it and its enjoyment upon the lifeless forms by calling them beautiful, because the motion of our eyes to which they invited us was beneficent for our sensual perception. Thus the eye seeks its objects, shuns them, and tarries upon them, according to the impressions transmitted to it by the outer world, and according to the impulses it receives from the mind and the feelings to be awakened. Thus we conclude, *vice versa*, from the external motion of the eye, upon the inner condition of the soul.

In the fullest enjoyment of their muscular activity the eyes move in curved lines. Therefore the free, manly look, moves in upward directed curves; the modest, bashful, feminine glance, under lowered eyelids, in downward, dejected curves, from point to point. But where the glance hastens in straight lines from one point to another, there the one-sided character of the motion betrays likewise intellectual one-sidedness, embarrassment, stupidity, or timidity. A more agitated glance indicates more rapid mental processes, passionate excitement; a more slothful one betrays obstructions in the life of the soul and inner relaxation. Where the play of the eye, unfettered, exceeds all bounds, the graceful, life-enjoying glance is converted into sensual, seductive intoxication.

When we wish to fix an object with our look, the optic axes of the eyes are brought nearer each other and their pupils contracted, and this so much the more, the more importance the observer attaches to the object of his attention. If the eyes rest upon a near object, with an almost parallel position of their axes and distended pupils, the glance obtains the expression of indefinite staring. If the axes, however, grow more inclined than is required by the nearness of the object observed, the glance expresses desire or concupiscence. When great thoughts move the soul, and the mind flees beyond the boundaries of the finite, the look likewise passes into the distance, and the optic axes are parallel. We endure easily and even with pleasure the tranquil look of others, but not their fixed glare, even when attached only to a spot on our dress. The annihilating look of an adversary is fixed straight towards our eye; a reproachful glance glides down from head to foot; with a hasty sideward glance the envious one measures the object of his envy; the look of contempt, however, no longer fixes its object, but would like to cause it to disappear while removing the optic axes from one another.

The look of one who in his close and constant occupation with ordinary, sensual matters, never extended his attention to anything beyond temporal cares and concerns, who never turned from the observation of facts to the investigation of the mysterious underlying them, is characterized by a short focus and a narrow pupil. The glance of the inquirer, on the contrary, opens the pupils, and brings the optic axes into a parallel position. This is also the character of the admiring look, which, overwhelmed by the impression received, stares at its object; of the glance of enthusiasm that searches infinite distances; and of the look of the dying, before which all surroundings vanish into gloomy mists. The old man and the child exhibit the same glare; the former seeks the distance, because the ties that unite him with earthly matter are gradually loosened; the latter still lives in intuition and admiration. Passion, too, excites the eye to rapid motion. Like a flash of lightning, rage or anger hurls its glance upon its object. More and more do the optic axes approach each other under the impulse of longing, of hope, of love, as if the eyes wished to draw the longed-for object within their reach. The eye of the sad, bashful, and timid, shrinks back from the object of its vision without daring to fix it or pass beyond it, and withdraws with a contracted pupil and lowered lid soon into itself.

Thus we can read in man's eye what permanently or transiently moves his mind, and the artist gives expression to it in paintings and statues. Not less intimate is the relation between the voice of man and the inner processes which it is to express. What is there more lovely than the gentle voice of a girl when it strikes upon our ear in song, or the sweet utterances of her speech! What is there more rousing than the powerful voice of man, when, on the wings of true enthusiasm, it roars through vast assemblies! What more touching is there than the trembling voice of old age! What more affecting than the cry of grief! What more seducing than the jubilant exultation of joy! When in the midst of verdant groves the voice of a child, ringing like a silvery bell, greeted our ear, did we not feel as if one of Nature's mysterious voices had become audible? But when, plunged into the admiring observation of the magnificent landscape, we were struck by the rude tones of vulgarity, the hoarse utterances of passion, the smooth voice of the flatterer, who ever could forget the disgust with which such tones disturbed our enjoyment of Nature's pure harmony by expressions of man's disloyalty to Nature? To be sure, the voice penetrates deeper than into our ear merely, and yet its secret power is more vested in its sound than in the words uttered by it. Who should not have experienced it that, when dear lips addressed him, he did not hear what they said, because he was listening only to the sound of the voice. The voice is the sound of inner processes, the expression of feeling. The word has nothing to do with feeling; and, if it be an offspring of feeling, it was a posthumous child. Language rather tends to cover feelings, as it is founded upon mutual agreement. He who endeavors to dress his feelings in words, conceals them, as the garment conceals the forms of the body.

The baby cries, as we often enough hear with dismay, but it never does so without cause. The feeling of displeasure produced in the child by bodily indisposition, or by an ungratified desire, finds vent in its cry. We adult persons do no longer cry, because we have learned to suppress our feelings, and to adapt our utterances to the requirements of custom. We do not cry, because within us grief and joy have attained to consciousness, and become objects of deliberation and judgment. We no longer utter our feelings, but the thoughts which they incite. The current of thought never dries up within us; our ideas crowd each other in restless haste, thus bringing now one, then another, to the foreground. But in the background of the soul still rests that vanished world of our childhood, with all the magic of unconscious feelings and unexplained presentiments. Dark clouds of grief, of sadness, of longing, of relaxing displeasure, hover around our thoughts; or a brilliant radiance of joyful hope, of serene cheerfulness, surrounds them. In the depth of the soul, behind a veil of transparent thought, often a second, darker series moves along, of which we become conscious only by means of indistinct feelings. They are those dispositions of the mind which often encompass long periods of life, and control the varied realm of ideas, obeying the will with difficulty, if at all—those dispositions which pervade the whole man in all directions, and remind us of that harmony, which, according to whether it is furthered or disturbed, forms the centre of all pleasure and displeasure. Every one feels them within himself without being able to explain them. But still less is he able to penetrate into the emotional world of others. Indeed, we do not know how to express in words what moves our own inner life as longing or hope, love or grief! Feeling enchains our thoughts into unity; it is the oscillating sea upon which our thoughts rise and sink like sailing vessels. But the waves of feeling beat against the shore and change its forms. Facial changes and gestures involuntarily accompany those manifestations of inner life, and the voice is the echo of the surging waves.

Thus facial expression and vocal sounds have their origin not in any mutual agreement of men, but in a natural impulse. They are movements, contractions of certain portions of our complicated muscular apparatus. By the slightest movements of our eyeball we often manifest the most radical changes in our mind, and by the play of our facial muscles we betray what moves our soul. The recollection of the effects produced by our own feelings in ourselves enables us to understand the facial expression and vocal utterances of others, and from outward signs draw conclusions as to their causes. We finally attempt to intentionally produce those signs and sounds which we have learned to recognize as outward forms of certain inner emotions, to communicate them to others, and thus sounds are transformed into words, into language. But words come short of thoughts, and seldom do muscular movements attain to that degree of freedom and ease which cause the spoken thoughts to pass from the dimness of feeling into the clear light of knowledge. Then, to be sure, we find developed in language the entire wealth of forms of mental activity; and the poet's imagination, the profundity of the inquirer, the energy of will, continue to produce their effects through the medium of words upon men down to succeeding centuries. Then language becomes an expression of the entire inner man, because it renders perceptible by the senses no longer the form of thought only, but its substance.

Vocal sound is the product of a muscular movement putting in motion a mechanism through which at all times joy and displeasure, as they pass through our soul, find involuntary utterance. The muscles of our vocal organs produce their effect by causing in certain elastic bodies a tension, through which at its relaxation masses of air are put in motion, or vibrations produced that are transformed into tones, similarly as in the case of vibrating strings between which a current of air is passing through. The lungs of man resemble a pair of bellows, that are sometimes contracted, sometimes expanded, during the act of respiration, by the elastic chest and the ventral muscles. By these bellows the air is forced through the windpipe or trachea, and the larynx. The latter, which constitutes the upper extremity of the former, is a cartilaginous cavity, the superior closing of which is called the glottis. Its various parts, anatomically considered, are extremely complex and intricate, especially in reference to its construction and physiology, as the organ of voice. Of the greatest importance for the formation of the animal and human voice are the two vibratile vocal chords which bound the sides of the glottis, and against which strikes the air driven by the muscles of expiration from the lungs through the trachea; thus producing a voice which varies in different animals according to the power of regulating the degree of tension of the chords, according to the size and shape and various complications of the laryngeal sacculi of the pharynx, of the tongue, and of the mouth and lips. As long as the air freely passes through the lungs in the act of respiration, we have no tone—at the most a breath. But, when the laryngeal muscles are contracted, the vocal chords are in tension and acquire an undulatory vibration; they produce a tone while the air passes them. The stronger their tension, the higher is the pitch of the tone thus produced; and the more vigorously the air is forced through the contracted glottis, the more vigorous are these tones.

Thus the vocal chords resemble altogether the strings of a guitar, the pitch of whose tones can also be raised by subjecting them to contraction or a stronger tension. Upon the original length of the vocal chords depends, therefore, in the main, the difference between the voices of men, women, and children. While the average length of the vocal chords of a man amounts to from 18½ millimetres in a state of rest, to 23⅙ millimetres at its maximum of tension, it varies with women between 12⅔ and 15⅔; with a boy 14 years old, between 10½ and 14½ millimetres. But the timbre of the voice, similarly as that of musical instruments, is principally determined by the hardness of the laryngeal cartilages. These are with children and women pliable and soft; with men, and many women whose voice has a masculine sound, hard, and often almost ossified. Finally, the cavities of the mouth, throat, and nose, the sounding cavities of the human voice, the palate, the teeth, tongue, and lips, form the tones by their varying position and tension into those definite vocal sounds which constitute human speech.

Thus, then, the simplest vocal sound is the product of a complicated muscular movement, and, as we infer from the play of the optic muscles, the inner condition of others, so the tones, produced by the similar play of the respiratory and laryngeal muscles, enable us to draw inferences from their high or low pitch, their vigorous or faint sound, the rapidity or slowness of their change, as to the mental disposition with which they originated. Like the facial features, so also the vocal chords relax at the sensation of grief and sadness, and the tones called forth by these mental dispositions, are accordingly deep and indistinct. Both facial and vocal muscles attain to the maximum of their tension in the exultation of joy and of enthusiasm, which, in consequence, find vent in high and loud tones. As the merry child leaps and jumps, and the features of joy change in quick play, so vary the tones of joy, now ringing high and now deep; and as the facial expression of seriousness grows fixed and stiff, so earnest, passionless admonition, speaks in a monotonous voice. The higher the excitement of passion rises, the more muscles are put in motion. Involuntarily we put obstacles in their way, as if looking for an antagonist that does not show his face, as if compelled to create objects for our inner excitement to which it could oppose its struggle. Then the jaws are compressed so as to cause the teeth to gnash, the hands are wrung, fists clinched, as if the nails were to pierce the flesh; then the vocal chords are stretched, the glottis contracts, and the air forced through it produces, in its struggle with the obstacles it meets, those high and strong tones of passion and of rage. Yet the excitement exceeds its bounds, the vigor subsides, the will is wanting to overcome the obstacles. The arms sink down exhausted, the mouth opens; and between the relaxing vocal chords, from the extended glottis, come forth deep tones. But, as the tones change involuntarily in accordance with the inner excitement, so they produce similar dispositions in the hearer. Tones are contagious; loud exultation carries us with it; complaint calls for our sympathy; the war-cry inspires us to bold deeds. This accounts for the magic power of music: In the sound of the instruments, the nature of bodies, their softness and firmness, their elasticity and tension, penetrates our soul and produces similar dispositions in the hearer, but in song it is the inner life of man himself that through the ear streams to the heart; it is the disposition which finds vent in song that awakens kindred dispositions within us. Tones of high pitch tell us of violent excitement, and with a forte intonation proclaim victory, while their piano in the attempted struggle betrays the failing strength to carry it to a successful end. Deep tones, when piano, make the impression of great relaxation and resignation; while forte they intimate free power, which, in its proud self-consciousness, seems to exercise itself in the struggle against self-created opposition.

From gradually swelling tones sounds growing strength, the victory over resistance, as indeed the tension of the vocal chords relaxes with the increasing power of breathing. Therefore the uniform tone produces so solemn an effect, such powerful excitement; and, as the trumpet summoned the knights of the middle ages by its single notes to single combat within the lists, so are we even now-a-days filled with solemn awe at the single blasts of the trombones. But when the swelling tones at the same time rise in pitch, the struggle is intensified, the excitement reaches its climax, and victory beckons from ever diminishing distance, while the ascending scale in its diminuendo causes us to realize the superiority of resistance. If the descending scale is intonated diminuendo, it has an oppressive effect upon our mind, which the simultaneous relaxation of the vocal chords no longer can lift up, as sinking strength is no longer raised by resistance. It is the picture of an inner decline, of a complete resignation and powerlessness.

Thus music is a language of man, and often more powerful in its effects than the most glowing eloquence. But every tone is transformed into an expression of the mind; the more distinctly the less intentional, the deeper it gushes from the chest. We should often understand each other much better if we paid more attention to the expression and tone of voice. Words are smooth and hollow, and may be borrowed by the understanding; but man's voice is his own, and the offspring of his heart. Many appear merry and cheerful because they are required to do so by regard to manners; but a gentle sigh, an oppressed utterance of their voice, betray the gnawing grief of their soul. "To understand all is to pardon all." This great saying of a noble woman ought to incite us to look ever for those small and apparently insignificant indications which enable us to better understand the feelings and actions of our fellow-men, to bear their faults, and to esteem and love them.

But look and voice are not the only outward indications in which the inner emotions of man's soul find expression. Yet, by whatever means the soul gives vent to its inner life, they consist in movements and contractions of single portions of complicated muscular apparatus. We learn best how to interpret them from those conditions in which the mind, when under any especially powerful excitement, is least able to control its movements by its will, when these appear most subject to the organic laws of nervous activity. These conditions are the passions; they only enable us to understand those gestures through which mental processes are intentionally made manifest.

All the movements of the body are dependent upon the contraction of muscles, all muscular contractions upon the activity of the nerves. What kind of a force is active in the nerves is a question still open for the solution of science. The microscope shows the nerves to be fibrous chords, consisting of numberless delicate filaments, and some of them having what are termed ganglia or rounded masses of nervous matter, not fibrous, but apparently composed of globules disseminated through a vascular network. Every filament is filled with a peculiar viscous gray substance, the constituent molecules of which can be put in oscillatory motion by internal and external influences, similarly as the portions of the air by the waves of light, heat, or sound. Thus they form, as it were, a closed galvanic circle, one pole of which lies in the brain, the other in the muscle to be moved, or under the external skin; while various groups of nervous cells distributed between them represent galvanic batteries, from which those currents issue that, like flashes of lightning, produce the connection between the internal centre and its external organs. Through the whole body, wherever there are life-supporting bloodvessels, wherever there is a possibility for sensation and motion, innumerable such filaments are distributed. Many thousands combine to larger trunks, in order successively to enter in an upward direction the canal of the vertebral column, in which they form a thick chord, the spinal chord, ascending to the brain. Like the telegraphic wire, isolated by their elastic sheaths, every filament propagates the process excited in it as far as it occurs outside of the vertebral column. Only in the spinal marrow it can communicate its condition or its vibrations to other filaments by the mediation of those nervous cells which here lie at definite points distributed between them in large numbers. However little these filaments in their structure and substance seem to differ, yet the activities of the various groups are very different. While in one only the delicate wave of light, in another only the coarser sound-wave excites sensations; in others the sensations of heat, of pain, of smell, or taste, are awakened by contact. Moreover, there are nerves, which, under certain impulses, produce muscular contractions, and finally such as may be injured without the sensation of pain, where mechanical irritation no longer produces any convulsions, and without which nevertheless neither any muscular motion, nor any interference of conceptions or other mental activities with the functions of the bodily organs is possible.

All these various groups of nerves are so wonderfully interwoven that the irritation of any single filament is often sympathetically imparted to all the others with irresistible necessity. A single affection of the will is sufficient to put in action the complete play of the nerves for a long time. Now, if it is a fact—as we must admit it so to be—that nervous activity is closely connected with mental activity, so called, no matter which be the cause or the effect of the other, we must recognize the possibility of drawing conclusions from a single nervous effect of this kind which meets our eye as to numerous others connected with it and of a more concealed nature, and consequently also as to their totality and their origin.

One of these groups of nerves has the function of inciting the motion of organs. Their fibres are, so to say, messengers of the mind, which invite the muscles to contract, and thus to produce the desired movements. Their trunks branch off in the muscular tissue into finer and finer filaments, until finally they are entirely lost in the tissue of the muscles. But this tissue appears under the microscope again as consisting of innumerable delicate elastic fibres, united by tender membranous coverings into single separate bundles. They possess the important property of contracting under the influence of the nerves, or of electric irritation, and then by the aid of the unelastic sinews, as by chords, to draw up and move the otherwise stiff limbs of the body. From the hardness of the muscle we can externally recognize the power of its contraction or tension. But this tension is only proportionate to the degree of resistance opposed to it. After this resistance has been overcome the muscles relax and return into a state of rest. A complete relaxation of the muscles does, however, never take place in living bodies. The elasticity of their fibres keeps them rather constantly in a certain state of tension. This tone of the muscles, as it is called, accounts for that beautiful rotundity of form which, even on the body of a sleeping person, gives the surest evidence of life, in contrast with the completely relaxed muscles of a dead body.

As we compared the nervous apparatus with a galvanic battery, we shall best be able to illustrate the influence of the nerves upon the muscles by calling to mind the rapidly succeeding shocks which we receive in our fingers under the influence of such a battery. Similar irritations, but succeeding each other with immeasurable rapidlty, which originate in the brain and spinal marrow, are conducted to the muscles, and there perceived in their total effect. Changes in the brain and spinal marrow must, therefore, of necessity become perceptible through the muscles. If the activity of the central organ is diminished or increased, these irritations follow one another more slowly, or are manifested in more violent single shocks. This, however, also puts an end to the muscular contractions, and gives rise to that trembling motion which is perceptible both in violent emotions of joy and anger and in pain, and at the decline of the entire nervous system. Here, too, we need only think again of the single violent shocks of a slowly turned rotatory magneto-electric machine, which at a more rapid rotation are combined into an almost uniform current, which we hardly perceive in any other way than by the tension of our muscles.

Although this trembling motion may affect the whole body, it appears, nevertheless, more frequently and perceptibly in some single portions of it, especially in the head, the lower jaw, the frontal muscles, and the hand-joints and knee-joints. Here as well as in other organs there are two groups of muscles which in their activity produce opposite motions of the organs. Some have the tendency of bending, others of stretching them, some of turning them to the right, others to the left, some forward, others outward. These opposite muscles, called antagonistics, and according to their specified functions distinguished as flexors, extensors, abductors and adductors, pronators and supinators, balance one another in a state of rest in such a manner that the slightest impulse originating in the nervous system immediately calls forth a motion in one or the other direction. The curved position which we generally observe in sleeping persons is caused by a slight ascendancy of the flexors over the extensors. Upon an alternate excitement of these antagonistics depends also the phenomenon of trembling. In the head we therefore perceive this trembling motion as an alternate turning from right to left and from left to right; in the hand as an alternating inward and outward motion; in the foot-muscles as an alternation of bending and stretching, which is the more rapid, the more the relaxation of nervous activity diminishes the counterpoise of the extensors against the pressure of the trunk. Therefore our knees quake when we are frightened; while the heaviness of the lower jaw during a diminished activity of the nerves in the muscles of mastication causes, under the influence of fright and pain, chattering of teeth and trembling of lips.

In this connection between nervous irritation and muscular tension consists the art of reading the features and gestures of men. From the particular kind of tension we infer the kind of sensation; from its extent we judge as to the power of inner emotion. The maximum of tension can be sustained by the muscle only for a few moments. This is the reason why the body, at the highest degree of passionate excitement, produces so digusting an impression—a picture which the artist, be he painter or sculptor, poet or actor, never should attempt to perpetuate. If we were always aware of the exact connection between the single muscles and the exciting nerves, we would be able without difficulty to judge from a single muscle in a state of tension as to the hidden processes in the mind. But only a very few are so familiar with the inner structure of their body that they could venture to found any judgments of this kind upon such knowledge.

He who does not understand the construction of a telegraph, the connection of its keys and signals, can look at its play and follow the movements of the index without knowing how to read its signals. Thus it is also with the noiseless language of that telegraph into which the muscular apparatus converts the human body. He who does not understand the laws of the nervous current, the connection and position of the muscles, and their significance for the entire organism, cannot judge from their motions and forms as to the inner processes and conditions of others. If, therefore, we meet nevertheless in many entirely uneducated persons with a knowledge of human nature which is essentially founded upon such observations, we must trace it to other resources which may to some extent take the place of anatomical knowledge. Here, too, as often, experience takes the place of scientific deduction. In ourselves we first realize that there is a relation between our sensations and external movements, and self-knowledge makes this comportment of ourselves towards the various influences of the outer world the best standard for judging the mental condition of others. With others we moreover often know the external cause and the manner of their inner emotions, and from a series of observations of such externally manifested mental dispositions we gain reliable criteria which enable us to extend our judgment even upon unknown ones.

Without the art of reading facial expression and gestures, intercourse between men would be hardly imaginable. We must have some information regarding a man's character and disposition before approaching him; constant distrust would ever keep us at a distance, or ever recurring misunderstandings and deceptions disturb us. The word which could lay open to us the inner condition of another covers it only too often; and the action, the surest standard of his disposition, may come too late. Therefore we allow ourselves to be led by experience, and from external forms and motions we form at least provisionally and in outlines an image of his mental nature. To be sure, we ought to bear in mind that a judgment founded in the main upon experience may easily deceive us, as our own personality always plays a prominent part in its formation. We like only too well to judge after the tendency of our own feelings and upon the ground of our own conduct, that we should observe under similar circumstances. This accounts for many a prejudice against others, for many a misunderstanding and disappointment. But even with the purest and most earnest desire we need not always expect to form a reliable judgment from certain facial expressions of a man as to certain mental dispositions. We all know, indeed, how zealously we often endeavor to conceal our inner emotions from the eyes of the world; how well strong minds often succeed in covering even the most violent storms in their souls, so that hardly a slight trembling of the lips or a passing motion of the eye betrays them. Rarely is a sensation pure and distinct; mostly it mingles with others, and is modified and covered by them. Yet the fact of a necessary and normal connection between inner and external motions is not to be gainsaid. Of course this connection can become manifest only when a single emotion seizes and controls the entire man.

Already the first attentive observations of a man in the state of passionate excitement must lead us to the anticipation of such a connection. Already the gradual expansion of muscular activity during an increasing excitement indicates a fixed law. If we follow this motion from its smallest beginnings, we see it at first hardly betrayed in slight oscillations of the eyes, then gradually transferred upon the facial muscles; finally also shared by the respiratory organs, and by the hands and feet. Stronger emotions are often manifested by the play of those muscles, which, symmetrically distributed in all directions, are united with one another by nerves; the will often obstructs their simultaneous motions, but, drowned by passion, it leaves them to the blind play of the nerves and the power of inner excitement.

If man were possessed of a separate organ for every mental activity, for every feeling, or could at least give peculiar expression to each, it would be easy to draw definite pictures of muscular motion for all the various conditions of his inner life. However, at the climax of passionate excitement, this is not the case; whatever may be its shape, it always exhibits the same picture of stiffness which seizes the greater portion of the muscular system. But, where this climax has not been reached, the will also has still some power—*i. e.*, still other influences interfere disturbingly. Then it is above all important to distinguish these voluntary muscular motions from those involuntary ones, and to recognize them from purposes, dispositions, or external circumstances, if we cannot directly use them to infer from them the inner emotions which they are intended to cover. Nowhere is it easier to draw with sure and sharp features an image of the soul as reflected by the mirror of outward forms and motions than in the common excitements of anger, of joy, and of pain, which seize upon us most rapidly and powerfully, and spring most directly from their source, and which therefore leave us the least time and strength to cover and misrepresent them. Direct your look upon that group of three figures forming so strange a contrast! A moment is sufficient to decipher their meaning. In the foreground you see a sinister-looking man with wrinkled forehead, and rolling eyeballs which almost threaten to spring from their sockets. His compressed teeth, his panting breath, his excitedly extended arms and clinched fists tell you of the wrath that rages within him. Now look at the pale woman by his side with the languid, sunken eye! In her staring look, her half-opened mouth, the lifelessly drooping arms, and bent knees, you read—without hearing her deep sighs—the complete picture of that grief which has broken the power of the mind, paralyzed the body, and stunned the senses! At her right, on the other hand, the blooming youth, with the vivid eye and radiant look, with the smooth forehead and the changing muscular play around mouth and eye—is he not the laughing picture of joy, as it decorates even the tired features of old age with the bloom of youth? But now let the scene be changed. The man's anger has subsided, the grief of the woman is soothed, the joy of the youth is gone. Only equally tranquil, smooth countenances look at you, all expressing the same disposition. You see no longer anything of the mighty excitements which only a moment before separated them so far in their outward appearance. Yet look more closely! perhaps those emotions left their permanent traces. Perhaps it was not a work of the moment which thus changed their features; perhaps that man knew already many hours of such angry excitement; that woman had borne many such sorrows; that youth laughed often in such joy. Repeated excitements, permanent dispositions necessarily called forth permanent features in muscles and face. You will find them there and know how to interpret them.

Those prominent features which extend over the movable, changing play of the facial muscles, give to the countenance that characteristic expression which allows us to cast the deepest glances into the soul and its life. They resemble the currents of lava, the valleys and ridges, over which the blooming gardens, forests and fields of the landscape extend. Like them they are the deeply impressed traces of a long, old story. He who has carefully observed those permanent features which life has unconsciously impressed in the pliable forms, who has thoughtfully investigated them and deciphered their history, can also understand that other language of signs and gestures through which we endeavor voluntarily to express those feelings for which we can find no words, or by which we feign to cover others. Though we call these motions voluntary, yet they are not such to the extent that they appear. Nature compels us rather here, too, to choose definite manners of expression for definite emotions. This we experience in the sensual organs which have the function of opening our inner life to the outer world, and which we arbitrarily open or close against the impression of the latter, according as these are agreeable or otherwise. While the eye is opened freely and widely when the soul is filled with astonishment and admiration, it is closed at the sight of the horrible; the head is turned aside and the hands cover the eyes. We open our mouth to admit the sound-waves more freely into the tympanum of the ear when we hear something new or incredible; but we stop our ear at the narration of something dreadful, because it destroys the harmony of our emotions just as violently as the shrill cry does that of tones. Thus we also close our nostrils with our hands, or hold our breath to prevent disgusting gaseous effluvia from affecting the olfactory nerves. Thus we intimate by the motions of our sensual organs the pleasant or disagreeable sensations which not only sensual objects, but even thoughts and conceptions, call forth within us.

All those muscular motions, by the aid of which we endeavor to manifest our inner emotions, become, distinctly speaking, indications of the latter only by reminding us of similar known impressions. If we, therefore, wish to distinctly express our emotions, we should endeavor to awaken the recollections of similar experiences by drawing as faithful a picture of them as possible. Thus we either can bring the causes of our emotions or their effects by gestures to the sensual perception of the other, and thereby compel him by a retrospective action of his imagination to produce the same emotions which correspond to these gestures. But while those emotions which were instanced before, and numerous others of a kindred nature, easily admit of such outward expression, there are a great many emotions of a more spiritual character which it is more difficult thus to represent distinctly and unequivocally. Just the deepest excitements of the soul, such as love, hope, bashfulness, belong to this number, and the gestures and expressions intended to make them perceptible to the senses are therefore capable of the most varied interpretation, and require the most careful observation and regard for secondary circumstances to render them intelligible.

But, so far as the language of facial expression and of gestures extends, it is subject to fixed laws which root in the unity of mind and body, and which, though apparently disturbed by the variety of causes affecting them, yet are the same in all climes and among all nations. They render it possible to acquire at least an approximative knowledge of the disposition and peculiarities of men, and to remove those prejudices which so often disturbingly interfere with their peaceful intercourse. For the true inquirer the words of Lavater still retain their truth to a certain extent: "All bodily motions of man are determined by his temperaments and character; every motion of the sagacious is different from the same motion of the imprudent; the wise man takes his hat in a different manner from the fool." Indeed, every motion is an expression of our inner life; we only must learn how to understand this silent language.

SUPERHEATED STEAM.

ITS DISCOVERY, PROGRESS, AND PROBABLE FUTURE.

THE history of the discovery of superheated steam and its subsequent vicissitudes is rather singular, and will be instructive, if considered in connection with what we have recently published on that subject. A minute description of experiments and facts appertaining thereto could not, however, be expected in this paper, nor is it intended as an exhaustive examination of the subject.

As early as 1831, Dr. Henry Haycraft, of Greenwich, England, obtained a patent for superheated steam, and believed he had discovered a power ten times greater than ordinary steam; but the subject seems to have attracted but little attention for nearly twenty years.

In 1849, Mr. James Frost, of Brooklyn, N.Y., who had been experimenting on this subject, communicated a paper to the Rumford committee of Cambridge University, in which he claimed that he had increased the power of steam four to six times, and that at 650° F. a change took place, forming a new vapor, which he called "stame." This, by subsequent investigation of others, appeared to be only anhydrous steam; but the term "stame" was used for years by many parties in the numerous controversies which arose in scientific journals on the subject.

The committee of the Cambridge University reported adversely on Mr. Frost's claim, but, in the discussion and experiments which followed for some years, various individuals declared they had obtained results equal, or nearly equal, to his statements. Mr. B. F. Isherwood, chief engineer, U.S.N., communicated to the Franklin Institute Journal the results of certain experiments made under his direction on the steamer Joseph Johnson, in the harbor of New York, A. D. 1854; stating that, with steam and surcharged steam mixed, a *gain* of power over steam was shown of 72.69 per cent. average in one series; and in another, where he mentions an unfavorable condition of fires, the gain of the same mixture over steam was 53.51 per cent. average. The report, (vol. 27, 3d series, p. 267,) concludes as follows: "From the experiments made thus far, no difficulty has been experienced from the burning out of the pipes conveying the surcharged steam. The data as given may be relied upon as truthful, and the reader can account for the result any way he chooses; of the practical facts there can exist no doubt."

Mr. Isherwood materially changed his opinion in 1860 to 1864, as we shall hereafter see, but the error was very natural, and arose from the rapid deterioration of the iron coils of pipe for superheating, which difficulty did not at first command the attention it deserved.

Messrs. Charles, John, and Samuel Wethered, large woolen manufacturers, of Baltimore, who had been experimenting on this subject for some time previously, obtained a patent May 25, 1853, for the use of superheated steam mixed with steam in the cylinder of the engine. The former they procured by leading a pipe from the upper part of the boiler, near the rear end, and continuing it in a coil, having about three square feet of surface per nominal horse-power through the heating flues, and directly over the fires, to the engine cylinder. These gentlemen obtained also patents in several European nations, but they never realized their hopes, nor indeed, we believe, even the money they expended. This arose from the difficulty of getting those nations and our own to introduce or experiment with it, and also because subsequently, in practice, very material modifications of arrangement were made through the discovery that, when a temperature of not over 360° F. is used, *no admixture* of ordinary steam was necessary. This greatly simplified the use of Wethereds' plan, but at same time injured the patent.

It is a fact that many manufacturers in Europe are now using this modified system of superheating to advantage, and the Peninsular and Oriental Steamship Company has a considerable number of its vessels arranged for this use, and a saving of 25 per cent. is claimed. It was also, a few years ago, in use on the admiralty yacht Black Eagle, and H.B.M. steamer Dee, and as a saving of 31 to 38 per cent. was reported, it is to be presumed it was further extended. Messrs. Boulton, Watt & Co. also applied a superheating arrangement to the boilers of the Great Eastern about the year 1862.*

The apparatus of Messrs. Wethered was added to the boilers of the ill-fated steamer Arctic, of the Collins line, but for some reason, never fully known, it was not used. Mr. E. K. Collins certainly had reason to be satisfied with the trials made with surcharged steam on his experimental engine with boiler of same model as the Arctic. These experiments were made at New York in June, July, and August, 1853, and are reported by Chief Engineer Isherwood, U.S.N., who superintended them, to the Franklin Institute Journal, (vol. 27, 3d series,) pp. 257 to 261. The *gain* of surcharged steam alone, as there shown, over steam, was 65 per cent.; and the *gain* of steam and surcharged steam, mixed in proportions of 25 to 75, was 106 per cent! The fact of far better effects being obtained from the mixture than from pure surcharged steam, proved the well-known lubricating quality of the water held by steam at 212°, and led to the belief for several years, from this experiment, that the mixture was necessary.

Several parties have received patents in this country for modified arrangements of the Wethered plan: L. R. Cornell, Flatbush, L.I., October, 1867; George A. Stone, (two,) 1859, 1860; Brown & Gregg, Gratis, Ohio, January, 1865; and S. N. Carvalho, of Baltimore, January, 1860. The last invention was intended to overcome the deterioration of the iron which occurs through its decomposition of steam at high temperatures; such prevention being effected by exposing other substances to the action of the surcharged steam. This plan was favorably mentioned in the Scientific American of July 2, 1860, and was tried at the Washington navy yard that year, and also at several machine shops in Baltimore. It was reported to work well, and effected a large saving; but its use has been discontinued at both places, for what exact reason we have not, upon inquiry, been able to discover.

About 1860, Chief Engineer Isherwood, U.S.N., undertook a series of experiments with an engine in New York city, having Waterman's apparatus attached, which was a steam-jacket around a steam supply-pipe, connected with a superheating arrangement when desired, and also a peculiar throttle valve. In the words of Mr. Isherwood, (Experimental Researches, vol. 1, p. 5,) "the plan was for the steam to heat itself, by means of the differences of temperature, due to differences of pressure produced by the use of a simple throttle valve." The idea was, not to heat to a high degree, but to test at lower temperature relatively, say 220° to 240°, considering this slight addition as adheating.

These experiments proved rather unsatisfactory for several reasons, one of which was the disproportionate size of the cylinder, and we may take as the result the following from the report, (Ibid., p. 34): "It appears, then, on the whole, so great were the refrigerating influences in the cylinder, that an adheating of 31.7° possessed by the steam on entering the valve-chest, obtained by the Waterman system of throttling, was inadequate to the production of any net gain in the cost of power."

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* J. E. Bourne, C.E.: Steam-engine, pp. 239 to 244.

In 1862, 1863, and 1864, the United States government instituted more thorough experiments, under direction of Chief Engineer Isherwood, on the bay line of steamers at Baltimore. The official report we have not seen, but are informed by one of the intelligent gentlemen who assisted in these trials, that an average gain over steam appeared of 18 to 20 per cent. The temperature was 300° to 350°, and "more economy would have been shown had the steam not been already considerably dried by the smoke flues passing through it." The steam in some cases was raised in the pipes to such degree, that boards placed in contact with them inflamed almost immediately. This must have been at least 800° F.; and green branches of trees, placed in tight cylinders, were reduced to charcoal by the surcharged steam in two hours.

From Mr. John Bourne's voluminous reports respecting trials in 1860, (Treatise on the Steam-engine, pp. 269 to 275,) on vessels belonging to the Peninsular and Oriental company, and the Russian Steam Navigation Company, we find that a modification of Wethereds' patent was used, (the arrangement of Mr. Penn,) being a coil of pipe 1½ inches in diameter, placed in the base of the uptake, wherein the steam was heated to 360° F. at the most. The saving reported in several detailed statements ranged from 23½ to 34 per cent., all being low pressure engines.

It would not be wise to argue the inadequacy for general use of superheated steam because of the difficulties its nature presents in practice. Many of the best parts of the present forms of steam-engines were slowly added, years after the first simple engines were made by Watt; the eccentric which moves the valves being due to the laziness of a bright boy, who arranged a string on the main shaft to do what he had been employed to do by hand. The successful application of steam-engines to railroads—the tubular boiler in its complete form, and all the grand marine engines—date no further back than about forty-five years. The difficulties which now restrict the use of superheated steam may all vanish in the future before additional discoveries and scientific research, just as we have, within only a few years seen, that the use of iron has been vastly extended and improved, for many purposes, by the simple discovery of the galvanizing process.

MINING AND METALLURGY.

THE following able review of M. Gruner's excellent work, entitled Studies of Blast Furnace Phenomena, from the pen of Mr. Gordon, his translator, possesses much that is interesting. The main point of novelty in the "studies," Mr. Gordon remarks, and that which gives them their chief interest, is the precision given to the doctrine, first distinctly taught by Mr. Bell, that the ratio of CO_2 to CO in the escaping gases is the index of the working of the furnaces. The determination of an analytical process of calculation in place of a synthetic, is of value for direct investigation of any case of blast-furnace working that may present itself. Still, the only question debated is the economy of fuel in furnaces, whether charged into the furnace and consumed there, or supplied from without, as caloric in the heated blast. It is only when furnaces are working with the same, or nearly the same charges of ore, flux, and fuel, (*i.e.*, same quality of raw materials,) and yielding the same quality of iron, that we can get comparative results of a reliable nature. Furnaces may be working in one region as well as in another, although using very different quantities of ore and fuel, and yielding very different quantities of iron, and showing very different profit and loss accounts. Pig-iron making, like other manufactures, must be looked at from both the purely technical and the economical point of view. There is a technical maximum of useful effect, and an economical maximum of useful effect. The technical useful effect would be so much the greater as the yield of pig iron from a given weight of carbon and ores of the poorer qualities is greater; whereas the economical effect often involves other considerations, such as the maximum production of iron of a certain quality, regardless of the maximum technical effect. In most cases the ironmaster is chiefly interested in the technical effect. There is, however, one factor of technical effect, viz., that of the superheated blast, which has for the last three years excited the liveliest controversy. The "section 25" of the "studies" treats of this question on the basis of the experience of Mr. Bell and others in the transactions of the Iron and Steel Institute, and on the assumption that the combustible for heating the blast is the gas of the furnace itself. M. Gruner's examination of the question, like that of Mr. Bell, is full of instructive applications of the actual theory of the blast furnace. The complete technical answer awaits the result of experience of the cost of superheating the blast.

To the question, whether there is advantage in heating the blast to 800°, 900°, or 1,000°, the theoretical answer is, undoubtedly, yes. For each rise in temperature of the blast, there is increased economy—abstraction being made, of course, of the cost of maintaining and firing stoves for heating the blast. At the same time, the economy decreases rapidly with the rise in temperature. The economy arising from each accession of 100° to temperature of blast, is much less from 800° upwards, than from 500° to 700°, and still less than between 400° and 500°; and thus, in practice, it is useless to exceed 700° to 800°. * * * * * After examination of all the facts hitherto published, it would appear that superheated blast beyond the limits of safety reached by the cast iron stoves, is useless; and if, as seems to be the case, it be thought necessary to erect generators of gas to heat brick stoves, that system is certainly wasteful, and a retrograde step in blast-furnace engineering.

——M. CARON, whose views upon the cause of "burning" in iron and steel have been published in this Review, is the author of the following method of tempering steel and regenerating burned iron. A piece of steel is generally tempered, and then reheated, more or less, according to the hardness or elasticity which it should receive. The dry temper, as commonly practiced—that is to say, the plunging the red-hot metal into cold water—has the drawback of developing cracks and crevices injurious to its tenacity. Reheating does not remove these flaws; and subsequently, upon use, these fissures, though invisible at first, increase and terminate in fractures. It has already been discovered, that, in order to escape from this danger, it is preferable to temper the steel a little less hard, and afterwards to reheat more slightly. The author claims to have succeeded in producing the combined effects of tempering and reheating in one operation, and of removing, as far as possible, the chances of flaws. This is effected by heating the water into which the red-hot metal is plunged, to 55° C. Tempering in hot, or even boiling water, modifies soft steel containing $\frac{2}{1000}$ to $\frac{4}{1000}$ of carbon. This process augments its tenacity and elasticity without sensibly affecting its softness: the texture is changed and becomes fibrous, even if previously crystalline. The author's method for restoring burnt metal is likewise to plunge it at red heat into a hot liquid.

Apropos of a kindred subject, the following item may have interest: It is known that steel, when quickly cooled after heating, assumes more or less hardness and brittleness; the color, texture, and density of the material being altered. As to the causes of difference between hardened and unhardened steel, there are merely conjectures. At a recent meeting of the Berlin Academy of Sciences, one of the secretaries, Dr. Du Bois Reymond, announced that a prize of one hundred ducats (about $200) would be awarded in July, 1876, to anyone who would best solve the problem, by experiment, whether the causes referred to were physical or chemical, or both. Accurate comparative analyses are required, especially of the relative quantities of carbon in the free and combined state, and also observations of the physical qualities of the materials. The memoir may be written in German, French, Latin, or English, and is to be sent to the academy (with sealed note and motto) before the first of March, 1876.

——IT is about eight years since the "cold fix" was brought to the attention of rolling-mill proprietors, and it is now highly appreciated as lining for puddling furnaces. It is in use in about one hundred rolling mills throughout the country. In the early use of pulverized ore as fettling, it was thought to give a red-short tendency to the iron; but this has long since been settled in the negative. In Pittsburgh, where it is employed in all the rolling mills, it has reduced the amount of coal consumption to thirty-four bushels to the ton of iron produced (2,240 pounds). This is the amount of fuel during the whole time that the furnace is with fire. A very great difference in the quantity of ore necessary is found between giving the puddlers a certain allowance, and permitting them to take as much as they please. Should the furnace need any slight repairing during the day's work, no trouble or delay is experienced, because, by this method of using the ore, sufficient can be put in to cover any spot needing it. The amount of scrap necessary is very much reduced; the necessity for keeping the furnace in a high heat long after the last ball has been drawn is obviated, and thus the wear and tear is materially lessened. The difference in the labor saved, by the use of the "cold-fix," makes it a matter of great importance, particularly during the summer months, as a better class of men can be had when using it, than when the ore is melted and used in the old way. It has, in many mills, taken the place of soapstone as material for repairing the furnaces; for, while soapstone does, under some circumstances, work into and injure the iron, the ore imparts nothing but what is beneficial. While there is a difference found in the quality of ore used, none that is fit for manufacture at all has been found unsuitable when pulverized, and by the use of water made into a kind of batter, like clay, according to the method.

——THE process of Jacobi for dephosphorizing iron ores, which has been in operation for some years, at Kladno, in Bohemia, is stated to have proved itself very successful. At the recent meeting of the German Society of Engineers and Architects at Prague, samples of cast and wrought iron made from ores purified by his process were exhibited which proved most decidedly the value of the metal. The details of the process of Jacobi are not given, nor are they stated, except very generally in his English patent, granted September 21, 1869. The principle, however, consists in dissolving out the phosphatic impurities of the ores by treating them with sulphurous acid, the wash water being utilized to extract therefrom the phosphate of lime.

——Very shortly after the discovery of gold in Summit county, Colorado, and the subsequent excitement that drew thousands of prospectors into its gulches and parks in search of the precious metal, a number of large galena lodes, says the Mining Review, were located, and a small amount of work done upon them. Several attempts were made to smelt the ore, but its poverty in silver precluded any profit, and the mines were gradually abandoned. Since then, a very large number of new veins of a similar character have been struck, but almost no development whatever, except in one or two cases, has taken place.

To obtain a good idea, geographically, of the belt of mines, it is necessary for the reader to consult a map and note the general course of the principal divides on the western flanks of the mountains. The main range on the south-eastern edge of Summit county makes a gentle curve to the south-west from Gray's peak to Mount Lincoln, of about thirty miles in length. From this divide a number of small creeks course north-westerly into the Blue river, among which are French and Georgia creeks, Gold run, and the Swan and Snake rivers, each having a number of smaller tributaries. Those above the Snake are found to be gold-bearing, and upon the divides between them have been discovered the most of the galena veins that we have spoken of. This belt is undoubtedly a continuation of the great belt of lead lodes that are first noticed in the southern part of Gilpin county. Farther south-west, in Clear Creek, the veins are generally charged in addition with zinc blende and most of the richer silver minerals, as silver glance, brittle and ruby silver, and gray copper. Still farther on, in Geneva district and Hall's gulch, the lead is not so much mixed with zinc, and contains more gray copper; and in the Summit County mines nearly all the minerals disappear, and a pure, clean galena is found in inexhaustible quantities, that, as a smelting ore, can hardly be surpassed.

In several of the gulches of which we have personal knowledge, the location of these mines is peculiar. They are found towards the head of the creek, and only on the south-west slopes of the divides. On the north-east slopes are found the gold veins from which has come the metal now being worked in the gulches. This is the case in French and Georgia gulches, in Gold run, and a portion at least of the Swan river. Whether it is true of the whole district, remains yet to be seen. Around Montezuma and St. John, and the headwaters of the Snake river, more or less zinc blende and other characteristic minerals of the Georgetown mines are found, and it is doubtful if any such regularity in the location can be shown. In the gulches named, however, the formation is very clearly marked, and is all the more curious as one side of each gulch is well covered, for hundreds of feet upwards, with rich gold-bearing gravel and dirt, and the other with large and strong veins of pure galena, carrying silver, and entirely free from any traces of the more valuable metal. So well known is this fact, that no attempt is made to work the northern slopes of the gulches for gold, and all the miners expect, and do find, the richest streaks of pay on the southern side of the creek bottoms.

The ore from these lodes is very pure galena, oxidized on or near the surface, and entirely wanting, in a majority of cases, in other of the base metals. We have not noticed zinc in any we have examined. Iron is sometimes associated with the galena, but as a rule it is nearly pure, and in large, bright crystals. The assays in silver vary from 10 to 400 ounces per ton, but the average value will not run up to 50, and perhaps not more than 40 ounces. In lead, from 50 to 60 per cent. can safely be relied upon n many cases, and there is a very large number of veins that will carry steadily over 40 per cent., hat can be traced for hundreds of feet upon the surface.

This belt of galena lodes extends beyond the Blue river into Ten Mile creek, and very possibly farther. From one end to the other there are hundreds of well-defined and large fissures discovered, and lying idle for want of the attention of energetic capitalists. As yet no attempt is being made to utilize these ores, except by Messrs. Spears & Conant, at Lincoln City, in French gulch. These gentlemen have erected a small reverberatory, 14 feet in length and 6 in width, and are working upon ore from the Robley lode, close by. At the middle of August, about 100 tons of ore had been extracted from the surface outcroppings, and the lode opened at a score of places for fully 600 feet. The ore is one of the best we have ever seen for smelting purposes—carries from 60 to 70 per cent. of lead, and 30 to 40 ounces of silver, and can be mined at a very small expense. The lowest workings (a shaft 45 feet deep) show a very strong lode, and a continuous vein of ore from 3 to 18 inches in width. It is greatly to be hoped that the workings will prove a success, as there are many other mines in the vicinity, of a similar character, only idle by reason of the lack of smelting facilities. The expenses and yield of this class of ore may not seem, at first glance, to show much profit. What it will be, can be seen from the following figures. Value of one ton of ore carrying 60 per cent. of lead and 30 ounces of silver, 80 per cent. being saved.

Lead, 960 lbs., @ 5 cents per lb., at Denver		$48.00
Silver, 25 ounces, @ $1.30		32.50
		$80.50
EXPENSES:—		
Mining	$ 5.00	
Smelting	10.00	
Packing of ore	2.00	
Transportation of pig lead to Denver, at $20 per ton	9.60	
Repairs and incidentals	5.00	
		$31.60
Profit, per ton		$48.90

——SIR FRANCIS C. KNOWLES presented recently, before the Society of Arts, a description of his method of refining and converting cast iron into either malleable iron or steel. His object is to effect the conversion without the waste of heat and material which attends puddling and other converting processes now in use. The gentleman named employs, as his source of heat, the combustion of gases rich in carbonic oxide, and mixed in due proportion with atmospheric air heated to 500° C. (868° F.). Having melted the pig iron in a cupola with coke or anthracite, he collects the gases, frees them, if necessary, from carbonic anhydride, enriches them by addition of free carbonic oxide, and is thus enabled to produce by their combustion a temperature of 2,500° C. (4,532° F.). If higher heat and greater rapidity be required, he uses the cupola gases for heating his retorts, and employs pure carbonic oxide, specially generated, and thus obtains a temperature of 2,979° C. (5,394° F.). In either case, the mixture of carbonic oxide and air is blown into the molten metal, thus producing carbonic anhydride and nitrogen at a high temperature; but this heat may be readily utilized, whilst the products of combustion are passed through kilns or retorts containing anthracite or coke, and the carbonic anhydride is thus reduced to carbonic oxide, which is again available for combustion. The finery or converter used in this process is peculiarly constructed, with the view of withstanding the high temperature to which it is subjected; and the interior is lined with a mixture of protoxide of iron, manganese, emery, bauxite, and caustic soda. A highly basic preparation is thus obtained for the lining, as it is considered desirable that the cinder should also be basic, not containing more than 30 per cent. of silica.

To eliminate the sulphur and phosphorus, caustic soda and rich oxide of iron and manganese are employed; and when superior iron and steel are to be prepared, the use of nitrate of soda or per-manganate of soda is recommended. So far as the oxidizing agents are concerned, therefore, the process proposed is only a modification of that of Heaton.

——A SAFETY apparatus, known as the Aërophane, or Denarouze mining apparatus, has recently been experimented upon by the British inspectors of mines. It is claimed to be the most efficient apparatus of its class thus far devised. By its use, and encumbered with a weight of no more than 8 or 10 pounds, it is said that a man may penetrate at once and to a great distance into a pit filled with choke damp, or with smoke, or with any other noxious gas, remain there for several hours, carrying at the same time a lamp with complete impunity. The machine, which has received a thorough test in the mines of France, Switzerland, and Belgium, will be tested in the English Wigan coal field, which, from the dangerous character of the mine, will afford an excellent opportunity for testing the practical value of the apparatus as a protection to life and property.

——THE recent report of a shipment of 100 tons of American pig iron from New York to Great Britain, has caused a revival of the statistics of the exports of American pig and bar iron from 1717 down to the beginning of the revolutionary war. With the figures thereof, many of the older readers of the Review are doubtless familiar, as well as with the facts of the parliamentary restrictions placed upon colonial iron manufacture, and the regulations as to the exclusive shipment of iron in British-built vessels. The statistics, however, serve as something of an answer to those who regard it impracticable that America should be an iron exporter to England. Prior to 1776, the pig and bar iron sent to England from the colonies reached their highest point in 1771, when they were: pig iron, 5,303 tons; bar iron, 2,222 tons. In 1740, 17,350 tons of pig iron were made in Great Britain, and 2,173 tons were sent there from the colonies. Such being done when American iron-making was in its infancy, and struggling against severe prohibitions, the question now arises, in how far the changed condition of affairs can stop our iron-makers, at the present advanced stage of the industry, from having a surplus which can be so disposed of.

——THE production of copper in the Lake Superior region during 1873 shows a gain upon the figures of the preceding year. The production of the Portage Lake district exceeds that of 1872 by 2,572 tons, and that of the Keweenaw Point district foots up 945 tons more than in 1872. The yield of the copper-producing districts—viz., 18,514 net tons of mineral, or about 14,500 tons of ingot copper—is said to be the largest amount ever obtained in one year from the copper mines of northern Michigan; and even better results are anticipated for the present year. The following figures show the copper production of each district:—

	Tons.	*Pounds.*
Portage Lake district	15,194	1,429
Keweenaw Point district	2,781	1,903
Ontonagon district	537	1,117
Aggregate for 1873	18,514	449

——LEAD which contains sulphur is so much harder than pure lead, that galena, or native sulphide of lead, is often fused with it to give it hardness. A small quantity of antimony has the same effect. By combining the two processes, and smelting together five parts by weight of lead to one part sulphuret of antimony, a bright, hard regulus is obtained, which may be added to ordinary soft lead in suitable quantities to produce the desired hardness. By fusing two parts of galena and one part sulphuret of antimony, sulphurous acid is given off, and a regulus of hard lead is obtained similar to the above, and consisting of sulphide of lead and antimo-muretted lead.

——THE British inspectors of mines report that they compute the quantity of coal raised in Great Britain in the year 1872 at 123,393,853 tons, an increase of 5,954,602 tons over the quantity raised in the preceding year. The production of coal in Ireland is so trifling that it is left altogether out of the computation. The quantity of English coal exported to foreign countries in 1872 exceeded 13,000,000 tons, and above 2,500,000 tons were exported from Great Britain to Ireland, leaving 107,500,000 tons for consumption in Great Britain—an amount over 5,500,000 tons greater than that of 1871.

——As a novelty worthy of record, we mention the erection and blowing in of an iron furnace within the limits of the city of Philadelphia—at Beach and Vienna streets. The furnace is 14 feet in diameter at bosh, and 60 feet high.——A GOLD-BAR, produced by the Spring Valley Canal and Mining Company, of Cherokee Flat, Butte county, California, in October last, was valued at $71,273.15 at the mint. It weighed, before melting, 3,580 ounces. The dimensions were as follows: 14 inches long on top, 13½ inches on bottom, 5 inches deep, 5½ inches wide on top, 5¼ inches wide on bottom. One ounce and eleven-hundredths were lost in smelting.——IT is stated that MM. Schneider & Co., of La Creuzot iron works, France, have 15,500 workmen employed in their furnaces, mills, and mines, which produce annually 50,000 tons of steel rails, 20,000 tons of iron rails, 100 locomotives, and other machinery. They have twelve blast furnaces, making ordinary and Bessemer pig metal.

INSURANCE.

THE report of the auditor-general's department of Pennsylvania shows for the year ending November 30, 1873, receipts from non-State insurance companies amounting to $353,490.78, being a tax on the Pennsylvania business of insurance companies not incorporated by the State of $292,708.63 for the 3 per cent. on gross premiums of 1872, and $60,782.15 for the old license fees (now repealed) for 1873. This is an increase over the previous year for taxes of $8,955.70, and a decrease of license fees amounting to $6,861.00. Both in regard to taxes and license fees, there was a decrease in the State revenue from the life branch. There were 109 whole-year licenses paid, and 28 for part of the year—chiefly new fire entrances. The growth of the State levy upon non-State companies during the last eight years has been as follows:—

1865	$110,551 96	1870	$279,878 89
1866	128,758 12	1871	332,933 60
1867	190,952 29	1872	351,396 08
1868	220,392 76	1873	353,490 78
1869	266,226 71		

For the last five years the fire and life premiums, &c., with the taxes thereon, were as follows:—

FIRE INSURANCE.

	Taxes.	*Premiums.*
1869	$ 67,849 01	$2,261,603 00
1870	62,735 57	2,024,519 00
1871	73,244 63	2,441,446 00
1872	82,838 00	2,761,300 00
1873	100,245 42	3,341,500 00

LIFE INSURANCE.

	Taxes.	*Premiums.*
1869	$142,548 85	$4,751,600 00
1870	149,613 32	4,987,110 00
1871	173,788 87	5,792,963 00
1872	199,291 90	6,663,030 00
1873	190,915 95	6,363,865 00

MISCELLANEOUS.

	Taxes.	*Premiums.*
1869	$ 1,951 16	$ 65,005 00
1870	1,524 99	50,833 00
1871	1,459 23	48,641 00
1872	1,623 03	54,100 00
1873	1,547 26	51,600 00

	Total License Fees.	*Total Premiums.*
1869	$52,877 69	$7,078,208 00
1870	66,105 01	7,062,462 00
1871	84,440 87	8,293,070 00
1872	67,643 15	9,404,330 00
1873	60,782 15	9,756,965 00

We present our usual table, showing the taxes paid by the respective companies in 1873, with the respective amounts of the three preceding years. The figures which we give are the official ones. Companies which have failed, or are winding up, are marked with a star (*).

Taxes (3 *per cent.*) *paid on premiums received by foreign insurance agencies in Pennsylvania in the years* 1870, 1871, 1872, *and* 1873.

FIRE.	1870.	1871.	1872.	1873.
Ætna, Hartford	$3,991 64	$7,145 57	$8,889 22	$10,691 47
*Ætna, N.Y.,†	783 24	851 11	....	338 35
Adriatic, N.Y	....	....	8 29	113 42
*Albany City, N.Y	1,293 59	1,088 10	197 97	....
Alemania, Cleveland, O	....	....	85 51	369 50
Amazon, Cincinnati	....	....	187 24	1,078 77
American, N.Y	....	1,000 02	....	....
American Central, Mo	....	....	....	444 40
*Andes, Ohio	....	1,018 40	4,027 66	....
Arctic, N.Y	....	....	393 39	92 97
*Astor, N.Y	424 79	417 36	....	212 43
*Atlantic, Brooklyn,†	572 43	1,009 94	543 10	224 60
*Atlantic F. & M., Providence,†	93 17	97 74	....	....
*Bay State, Worcester, Mass	....	....	57 95	135 36
*Beekman, N.Y	....	35 54	....	....
Black River, N.Y	....	....	....	319 96
Brewers, Wisconsin	....	....	....	521 16
*Buffalo City, N.Y	288 27	625 17	....	....
*Buffalo F. & M., N.Y	290 19	489 11	....	....
*Capitol City, N.Y.,†	84 11	132 68	47 57	....
*Charter Oak	197 01	383 70	....	....
Citizens, N.Y	254 36	416 45	503 06	504 82
*City, Hartford	788 84	996 57	763 79	....
*Cleveland, Ohio	228 24	....	....	....
Columbia, N.Y	....	....	92 01	....
Commerce, Albany	349 97	497 60	556 86	384 79
Commerce, N.Y	193 56	69 89	317 68	464 23
Commercial, N.Y	....	....	156 89	162 29
Commercial Union, London	....	....	929 07	1,057 76
*Commonwealth, N.Y	1,153 95	309 25	....	....
*Connecticut, Ct.,†	212 02	171 24	285 35	471 05
Continental, N.Y	863 09	1,715 54	2,906 33	2,951 02
*Corn Exchange, N.Y	426 51	211 96	....	....
Eastern, Bangor, Me	....	....	158 68	322 80
Enterprise, Cincinnati	346 12	385 72	....	....
*Excelsior	281 77	530 13	....	....
Exchange, N.Y	....	....	29 00	213 10
Firemen's Fund, California	275 22	342 14	533 12	424 44
Firemen's, N.Y	189 41	271 11	317 28	224 08
*Franklin, Boston	....	....	189 12	....
Franklin, West Virginia	....	....	....	754 73
*Fulton, N.Y	384 52	835 30	....	....
Germania, N.Y	1,502 92	2,128 23	3,549 61	2,974 04
German American	....	....	....	1,787 58
Glens Falls	695 19	478 89	....	....
Guardian, N.Y	....	....	63 28	124 75
Hamburg-Bremen, Hamburg	....	....	....	58 62
Hanover, N.Y	939 63	715 63	2,079 36	2,555 34
Hartford, Ct	2,817 31	2,671 53	3,176 76	3,303 44
Hibernia, Ohio	....	....	....	338 07
*Hide and Leather, Boston	162 58	427 43	113 73	....
Hoffman, N.Y	....	....	....	800 52
Home, N.Y	2,716 52	4,462 73	4,907 77	4,967 00
*Home, New Haven	2,048 79	....	....	....
Home, Ohio	....	105 82	870 18	571 13

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† Reorganized after Chicago fire.

Fire.	1870.	1871.	1872.	1873.
Hope, N.Y	$ 447 92	$..........	$..........	$..........
Howard, Baltimore	172 12	....	....	....
Howard, N.Y	62 66	68 24	136 28	238 46
Imperial, London	938 41	1,899 42	2.827 73	3,877 00
*Independent, Boston	200 96	619 41	....	....
*International, N.Y	1,455 83	1,403 83	1,902 75	422 77
*Irving, N.Y.,†	266 05	350 48	101 74	97 77
*Lamar, N.Y.,†	95 11	201 57	102 98	258 23
Lancashire, England	....	....	....	936 41
Liverpool, London, and Globe	1,155 88	2,715 88	3,854 83	3,327 42
London Assurance Corporation	....	....	....	924 70
*Lorillard, N.Y.,†	625 61	1,470 39	....	258 64
*Manhattan,†	857 47	2,064 56	691 59	896 39
*Manufacturers, Boston	....	....	447 98	49 26
*Market, N.Y	318 96	419 84	287 53	40 85
Maryland	264 15	203 35	....	....
Mercantile, N.Y	194 18	196 74	408 53	392 86
*Merchants, Hartford,†	686 33	795 07	....	....
Merchants, R.I	336 76	533 72	417 46	342 71
*Merchants, Chicago	282 84	340 10	....	....
*Merchants and Mechanics, Baltimore	264 10	250 75	....	....
Merchants National, N.J	....	....	....	238 55
Meriden, Ct	....	....	....	175 94
Metropolitan, N.Y	678 75	295 94	....	....
Mississippi Valley, Tennessee	....	....	....	160 11
Narragansett, R.I	322 10	545 64	....	....
*National, Massachusetts	671 32	897 19	986 96	706 92
National, Baltimore	225 11	98 30	....	....
*National, Maine	....	17 08	417 43	122 25
National, N.Y	....	....	103 39	....
National, Ct	....	....	....	936 29
*New Amsterdam, N.Y	156 87	160 75	98 60	....
New York and Yonkers	....	....	....	242 20
Niagara, N.Y	1,018 42	1,641 60	2,196 93	2,050 98
*North American, Ct	813 38	1,012 99	....	....
*North American, N.Y	481 58	....	593 61	....
North British and Mercantile	1,491 34	3,653 10	3,402 92	3,080 43
*North Missouri, Mo	....	....	....	273 10
Northwestern National, Wis	....	....	....	281 34
*Norwich, Ct	474 29	361 52	....	....
*Occidental, California	109 73	280 26	....	....
Old Dominion, Virginia	....	....	....	192 79
Orient, Ct	....	....	....	1,066 70
*Pacific, California	1,024 79	1,522 54	1,025 59	....
*Peoples, Massachusetts	326 36	996 41	1,259 12	419 34
Peoples, Trenton	....	....	....	226 34
*Peoples, California	....	22 21	72 49	....
Peoples, N.Y	84 11	....	....	....
Phenix, Brooklyn	1,030 82	1,017 28	1,391 94	1,766 07
Phœnix, Ct	1,546 69	1,228 93	2,447 68	2,370 83
*Providence Washington, R.I.,†	445 57	379 98	82 18	109 96
*Putnam, Ct	1,327 14	1,023 82	1,218 49	....
Queen, Liverpool	764 92	1,666 22	1,548 02	3,364 64
Relief, N.Y	185 70	197 65	230 90	....
*Republic, Chicago	635 48	403 28	....	1,443 85
Republic, N.Y	71 28	....	1,166 91	1,144 55
*Roger Williams, Ct	114 88	263 04	170 25	....
Royal Fire and Life, Liverpool	9,389 46	8,884 69	11,156 87	12,580 27
*Security, N.Y	1,462 35	1,915 18	....	1,122 35
Springfield, Massachusetts	814 07	1,046 09	1,208 88	1,892 85
St. Joseph, Missouri	....	....	....	220 08
St. Nicholas, N.Y	....	....	84 43	148 20

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† **Reorganized after Chicago fire.**

Fire.	1870.	1871.	1872.	1873.
St. Paul, Minnesota	$...........	$...........	$...........	$ 143 23
Standard, N.Y	409 38	352 56	427 87	412 65
Star, N.Y	....	....	244 79	436 13
*State, Cleveland	425 63	447 69	....	....
Tradesmens, N.Y	167 17	120 96	22 15	149 09
*Triumph, Cincinnati	....	....	498 36	....
Union, California	11 50	337 73	676 21	....
Union, Bangor, Me	....	....	642 70	441 62
*United States F. & M., Baltimore	990 10	....	....	....
Virginia, Richmond	....	....	....	67 66
*Washington, N.Y	352 95	515 82	....	....
Watertown, N.Y	....	....	....	137 42
Westchester, New Rochelle, N.Y	....	....	1,316 12	2,166 90
*Western, Buffalo	828 47	745 29	....	....
Williamsburgh City, N.Y	....	....	29 97	410 45
*Yonkers and New York, N.Y	411 42	1,005 00	....	....
Life.				
Ætna, Hartford	7,620 59	11,534 55	12,191 78	11,995 03
*American Tontine	454 17	....	....	....
*Amicable, N.Y	....	70 64	172 61	....
*Anchor, N.J	12 36	134 02	515 74	....
Asbury, N.Y.,‡	566 50	707 36	667 87	767 42
Atlantic, Albany	1,023 03	1,865 48	1,829 20	1,423 77
Berkshire, Massachusetts	918 23	1,483 17	1,392 65	1,395 61
Brooklyn, N.Y	1,293 94	1,124 13	1,076 04	1,015 53
Charter Oak, Ct	6,935 93	5,570 61	5,446 59	8,171 06
*Commonwealth, N.Y	61 90	....	67 85	....
Connecticut General	1,040 16	1,306 91	1,445 83	1,502 96
Connecticut Mutual, Hartford	6,472 41	15,970 48	21,271 76	19,804 37
Continental, N.Y	2,314 76	4,223 10	5,881 04	6,020 05
Continental, Hartford	2,996 95	2,474 97	2,152 39	2,633 00
*Delaware, Del	377 50	375 13	316 31	....
*Economical, Providence	581 90	731 02	843 09	704 13
*Empire Mutual, N.Y	41 39	458 00	1,116 04	673 06
Equitable, N.Y	10,947 39	11,594 58	11,525 97	10.529 97
*Excelsior, N.Y	12 28	146 45	912 83	1,167 02
Germania, N.Y	1,245 88	2,583 02	2,910 91	1,829 21
Globe, N.Y	392 50	1,964 12	2,626 46	1,104 67
Government Security	....	....	....	18 95
*Great Western, N.Y	831 09	....	....	....
Guardian, N.Y	1,842 84	3,442 00	3,028 45	2,953 51
*Hahnemann, Cleveland	237 73	719 12	....	....
Hartford Life and Annuity	621 82	780 32	928 04	840 93
Home, Brooklyn	827 27	796 62	789 93	619 01
Homœopathic, N.Y	....	34 12	69 75	279 11
*Hope, N.Y	....	397 63	851 70	971 75
*International, N.J	365 25	39 51	1,205 22	496 50
John Hancock, Massachusetts	597 68	1,324 29	1,522 46	1,208 51
Knickerbocker, N.Y	4,023 98	3,777 67	3,815 13	6.008 62
Life Association of America, Mo	....	413 91	1,188 88	1,435 88
Manhattan, N.Y	1,779 90	3,016 91	3,113 61	3,019 85
Massachusetts Mutual	2,158 30	3,024 67	2,754 86	2,966 70
Merchants, N.Y	....	61 79	55 39	....
Metropolitan, N.Y	379 49	1,610 20	1,817 72	2,131 34
Mutual Benefit, N.J	13,538 36	18,511 91	17,619 38	18,155 82
Mutual Life, N.Y	35,356 40	36,533 60	41,228 33	32,878 55
*Mutual Protection, N.Y	2 65	90 45	....	42 00
*National, Chicago, Ill	....	....	30 63	195 00
*National, N.Y	551 68	630 90	3,093 26	197 40
National, U.S., Washington	3,045 06	3,637 98	....	3,363 91
*National Capitol	....	382 81	656 38	....
New England Mutual, Massachusetts	7,217 62	7,727 07	7,364 06	7,234 57

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‡ Ceased new business.

LIFE.	1870.	1871.	1872.	1872.
New Jersey, Newark	$ 465 64	$ 520 22	$1,067 57	$ 501 57
New York	8,241 46	8,315 06	8,956 97	7,925 87
North America, N.Y	4,958 24	4,901 94	4,805 21	4,575 61
Northwestern, Wisconsin	2,823 00	4,166 76	4,793 80	4,870 92
Phœnix, Ct	....	2,162 64	2,611 74	3,657 39
Piedmont and Arlington, Virginia	....	....	1 23	69 53
Republic, Chicago	....	590 59	273 60	....
Reserve, N.Y	....	....	....	2,008 40
Security, N.Y	1,146 29	1,231 38	1,002 85	944 18
*St. Louis Mutual	707 36	400 03	522 82	511 34
Teutonia, Chicago, Ill	....	....	85 51	46 96
Travelers Life and Accident, Ct	1,918 94	2,437 97	2,876 98	3,420 68
Union Mutual, Maine	542 19	719 06	891 39	1,613 59
United States, N.Y	1,943 31	1,099 78	1,002 20	1,130 98
Universal, N.Y	560 96	32 17	189 12	133 78
Washington, N.Y	4,313 67	3,962 07	3,718 77	3,285 40
*Widows and Orphans' Benefit, N.Y	2,656 36	4,808 95	401 06	....
World Mutual, N.Y	578 01	....	580 45	527 95
MISCELLANEOUS.				
Hartford Steam Boiler, Ct	389 00	586 92	786 90	717 56
Railway Passengers, Ct	1,135 99	872 31	836 13	829 70

——FOR January 1, 1874, The Insurance Company of North America, Philadelphia, shows a total of $3,287,831.64 assets, (of the usual high character,) being the greatest amount of assets yet reached by the company. The business of the year discloses able and successful resistance to the disasters of flood and fire which marked the period—at times threatening the destruction of all underwriting safeguards—and the annual account closes with the net surplus materially enhanced, and a dividend of 10 per cent. to the stockholders. Losses, fire and marine, paid during the year, $2,294,784.66—swelling up the total indemnity afforded to the public, in the 80 honorable years of this company's existence, to $34,000,000. 1873 closed with a comparatively small balance of unsettled claims, viz., $239,500—Boston all liquidated, and not a single loss arising from the great conflagration resisted. Conspicuous as a marine, as well as a fire office, the North America encountered in the winter of 1872–3 another of those momentous periods occurring in its long history. Marine calamities bore with crushing effect upon marine writers, and brought this interest to a crisis which checked an indiscreet competition, and was otherwise the precursor of needed reforms, in which rates advanced to a remunerative standard, under the influence of which the latter half of the year somewhat redeemed the misfortune of the earlier months. In the case of the North America, the marine losses paid in the year were 75.2 per cent. of the earned premium. This branch of the company's business is now organized upon a basis perhaps never before equalled, and the company's reputation at the ports of the commercial world secures it the most desirable of the risks.

In a measure it may be said that the fire branch has been reconstructed, or rather, the underwriting has shaped itself to meet the exigencies which press upon the attention of the intelligent insurance official. In so doing, the risks, in the midst of opportunities to expand the business, have been decreased from the previous year, and premium receipts not decreased—thereby the fractional advance in rate, called for by the enhanced fire cost, gives the advantage of less danger to equal resources.

By the work of 1873 this company stands before the world improved even upon its own previous high standard of safety. Yet the directors proceed further, and have arranged to consummate the increase of stock capital, under the supplement to charter passed in 1871. This done, the stock capital of the North America is to be $1,000,000. The making up of the new capital has afforded a significant evidence of the estimate in which the company is held by the public. To stockholders, registered as such January 1, the right to subscribe to the new stock was accorded, in the proportion of share for share—such shareholder having liberty to dispose of this privilege. Such options have sold at a figure equal to the par value of the stock—*i.e.*, $10—the old stock at the same time commanding $28 in the market.

——PROMPTLY the Pennsylvania insurance department furnishes to the companies its blank forms for statement of condition at close of year, and report of business during the year. For the mutual fire companies of the State a special form of return has been prepared; for all joint-stock fire and marine companies, and all life companies, the National Convention blanks and balance-sheet have, with very slight changes, been adopted by the department, as the respective standards by which the returns of the companies are to be made out. Though insurance companies have existed in the State for 121 years, and about 80 per cent. of those which have been started have failed, this is the first attempt to give the public an account of such companies adequate to the disclosure of their respective positions, excepting in so far as expositions have been made through Pennsylvania companies entering other States to do business. The returns require the distinctive business done in the State during the year to be reported, with respect to risks taken, premiums received, losses paid and incurred, life insurance in force, &c. The Pennsylvania statement follows other departments in rejecting judgment claims and non-premium bills receivable (not loans on collateral) from the assets. State deposits are divided into two classes—1st, those held for security of all policyholders, and, 2d, those held exclusively for the protection of the policyholders of the deposit-holding State.

There is a liability item in the fire blank, which has its most direct applicability in the case of Philadelphia companies. This is the charging of 50 per cent. reinsurance on the "interest premiums of perpetual fire risks." By the perpetual system, the year's interest on the deposit is the year's premium for the year's risk. Assuming one-half of this interest as premium earned, the other half is charged as liability. So the perpetual liability is, besides the 95 per cent. of deposit reclaimable, one-half of the annual interest on such deposit.

In the life blank the unadmitted assets include all the items generally recognized as unavailable. Recent experience introduces a new item under the head of Income, viz., "cash premiums from other companies for assuming or reinsuring their risks." Rather unpleasant as a standing inquiry. The two classifications, viz., Exhibit of Policies and Reinsurance Reserve, cover the varieties of the life contract. Twelve miscellaneous questions are appended, 5 and 12 of which we cite, viz.:

> 5. Has any policy been "marked off" or reported "not in force" on the 31st day of December, on which any legal claim could have been made either for full paid insurance, for reinstatement, upon complying with certain prescribed terms, or for a surrender value? If this has been done, a registry list of all such policies is required.
>
> 12. Does your company issue any policies in which the Tontine principle is combined with life insurance? If so, make a registry of each group, and full detailed description, from which an accurate calculation can be made of the liability of the company on account of these Tontine obligations, together with the company's own calculations of its liability on this particular account.

With regard to the basis of its inquisition, the new Pennsylvania department shows itself equal to older bureaux, up to all the line of inquiry which department experience has been able to suggest so far; and the tone of the address which the commissioner makes to the officers of the companies indicates that, to the extent of his ability, the returns which he seeks—the true ones—must be had without evasion, concealment, perversion, or any mode of misrepresentation.

——WE have received advanced sheets of the Tariff of Rates on Schedule System of the Buffalo board of fire underwriters, of which board J. De W. Churchill is the surveyor. The tariff is a specific rating of the designated risks, and gives, with the charges on buildings and contents respectively, the height and area (square feet) of the former, also width of street. There is considerable diversity of rate in the same general classification of hazard, as each risk has been affected by the scheduled items—*i.e.*, charges for deficiency from the standard building. The list is a useful record of the dimension and location of buildings, though the influence of the cubical capacity and height of the building appears to be very indefinite under the operation of the other circumstances controlling the risks.

Schedule rating is a very systematic pricing of risk—the surveys define the distinctive individual character of the subject for insurance, and whatever assumptions there may be in the basis rate and the additions thereto, they are brought to the test of an experience which comes under definite lines of observation and record.

——By the fifth annual State insurance report, the life business done in Illinois in 1872 was as follows:—

	Policies Issued.		Premiums received.	Ratio of losses paid to premiums received.	Illinois Policies in force, December 31, 1872.	
	Number.	Amount.			Number.	Amount.
8 Chicago companies......	7,005	$ 8,764,542	$ 375,622	34.52	8,626	$ 12,530,220
51 Non-State companies...	8,878	22,183,194	4,216,917	28.65	47,561	111,658,263
Aggregate..................	15,883	$30,947,736	$4,592,579	29.14	56,187	$124,188,483

The following table gives a comparison of the life business of the State in the years 1869, 1870, 1871, 1872:—

Year.	Number of companies.	Policies Issued.			Premium receipts, including renewals.	Losses incurred.	Rcurred or In to premi- paid um receipts.
		Number.	Amount.	Average.			
1869..........	70	18,953	$43,066,689	$2,272	$3,885,072	$ 736,763	18.96
1870..........	74	20,539	45,047,902	2,193	4,955,920	836,601	16.88
1871..........	66	16,110	31,346,895	1,946	4,544,232	1,081,233	23.79
1872..........	58	15,883	30,947,736	1,948	4,592,579	1,337,935*	29.14
Average.....	67	17,871	$37,602,305	$2,090	$4,494,451	$ 998,133	22.21

The accident companies show, at the close of the year, 1,724 policies in force, insuring $4,425,355.

Illinois Life Insurance Companies.

Name of Company.	Amount of guarantee capital.	Income of the year 1872.	Per cent. of income of 1872 paid or applied				
			For expenses.	Purchased and cancel'd policies.	Dividend to policy-holders.	For losses.	To reserve.
Chicago.......................	$125,000	$178,931 48	41.17	14.86	10.77	13.97	19.23
International.................	107,950	24,118 52	9.96	2.49	....	13.45	74.10
Mutual	200,000	306,886 61	49.25	14.45	.85	12.33	23.12
National.......................	240,000	273,708 42	50.17	1.83	....	42.72	5.28
Protection	146,500	123,206 98	52.13	....	....	30.68	17.19
Republic	848,610	754,214 30	41.99	6.97	1.04	17.72	32.28
Safety Deposit	185,825	12,661 33	97.77	2.23	....	....	....
Teutonia.......................	194,207	123,574 86	52.15	10.89	1.88	23.22	11.86
Total..........................	$2,048,092	$1,797,302 50	46.72	7.95	1.78	21.32	22.23

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* Losses paid in 1872.

——EARLY and well the Provident Life and Trust, of Philadelphia, reports for 1873. We let the figures tell their own story as to the result of the year:—

Receipts, less Agents' Commissions.

1872...... $495,633.61 | 1873...... $610,261.29 | Increase in 1873...... $114,627.68

Amount Insured.

Dec. 31, 1872...$12,571,497 | Dec. 31, 1873...$15,551,136 | Increase for 1873...$2,979,639

Life Fund, (exclusive of Capital.)

Dec. 31, 1872...$1,159,881.94 | Dec. 31, 1873...$1,534,785.34 | Incr. in 1873...$374,903.40

Amount of new insurances in 1873, over $4,500,000; amount in 1872, $3,000,000; showing an increase in new business in 1873 of over 50 per cent. above 1872. A favorable mortality experience continues to vindicate the Provident's expectation in regard to its selection of risks. Deaths numbered 32 in '73, against 39 in '72; the interest income of 1873 paid the death losses of the year.

The history of the Provident is testimony to one fact: that where public confidence is not shaken, and monetary troubles do not bring in their obstacles, life insurance is as desirable to the people as ever—and perhaps is more desired by them than ever. Working in truth—in earnest, honest faith—without the mere glitter of enterprise or any false lures, this company seems to us peculiarly fitted to aid in clearing the doubts and dispelling the clouds which have temporarily gathered about beneficent life insurance.

——THE manner in which the subject of insurance is handled by the general newspaper press is often a subject of amusement to the professional journalist, though generally the latter prefers to laugh in private rather than in print. But, while to the general writer lack of information on a specialty is excusable, the specialist who blunders equally into an error writes himself down as an ignoramus. We notice a statement going the rounds, and repeated by some who should know better, that in France the fire policy never covers loss on premises where the fire originates. Now, on the contrary, the French policy provides a broader indemnity than the English or American; not, however, as the outcome of its essential character, but to meet peculiar exigencies existing in France. The Code Napoleon brings to strict account both owner and tenant of the building where the fire begins: that is to say, the Code makes fire no exception to the general rule that one must be responsible for damage to other's property which occurs through himself or his property. The owner is liable to tenant and neighbors (if the occupant can show that the origin of the fire was beyond *his* control), but otherwise the occupant is answerable. This liability for communicating fire is provided for in the policy, which, in addition to the direct subject of the underwriting, gives its guarantee for claims of tenant against the owner; also, the tenant's own risk and claims of neighbors. So, with or without insurance, each is to make others secure from fire loss—the insurance, however, serving to make the otherwise doubtful indemnity certain.

——BRAVELY the Pennsylvania Fire Insurance Company of Philadelphia has overcome the Boston disaster. It would be sufficient to illustrate the character of this honorable office simply to remark, that while losses to the amount of $1,058,083 were paid in the last two years, the assets footed up $1,366,680.69 January 1, 1874, against $1,189,325.46 January 1, 1873—a conclusive evidence that the severity of fire experience has not impaired the Pennsylvania as one of the most reliable securities against fire in the country. The assets are of the old substantial character, nearly $1,300,000 being in good interest-bearing investments and cash. After the Boston fire, the stockholders promptly restored the capital to its integrity, and the full liabilities, constructive and matured, (including the stock capital,) are $1,265,210.71, showing the company to be in possession of a net surplus. The business and agency system of this company are now established upon a basis to secure the best results. We need offer no new endorsement of the officers and directory of this institution. It would be but to reaffirm the testimony of nearly half a century—to repeat what the public is already familiar with. Unshaken commercial honesty, the wisdom of experience, the lessons of trial, guide it and maintain its high standard.

——SYNOPSIS of the rules of the Pennsylvania insurance department for the admission and regulation of non-State companies:—

Documents to be filed in Department Office.

Charter of company. When charter which has already been filed with auditor-general has been amended, amended charter must be filed. Resolution of board of directors appointing the agent and attorney. Power of attorney. Statement in form prescribed. Certificate naming sub-agents.

Service of Process.

Power of attorney to authorize insurance commissioner to accept service of process when company shall fail to maintain agent in the State. Power of attorney is to be given to one person, not to a firm.

Statement.

Annual statement must show condition on the 31*st day of December* preceding, and business for the *year* ending that day. Statement is expected at the *earliest* day practicable after close of the year; *must* be filed before the first day of March. Company making application for the first time to enter the State, must make statement up to the last day of the month immediately preceding date of application. Companies applying for the first time in January and February, 1874, are permitted to make statement to December 31, 1873.

Agents.

It is unlawful for any person to act as an agent of a company without certificate of authorization by the department. Certificates will be issued to individuals only, not to firms. Companies must notify department of removal of agents or appointments of new agents.

License.

Statement, power of attorney, and charter being filed, and the commissioner *satisfied* of the solvency of the company, he will issue a certificate of authority to do business in the State for the current year. In renewal of license expiring December 31, 1873, all necessary time allowed to comply with act of April 4, 1873; but this gives no permission to a company not previously authorized to do business, under an assumption that certificate will be granted; such act is regarded by the commissioner as *prima facia* evidence that the company should not be admitted.

Other-State Certificates.

Every applying company from a State having no supervision over insurance, must submit to an examination. Where there is a State officer having such supervision, his certificate of the condition of a company will *generally* be accepted as satisfactory.

Undoubted Assets with Small Stock Capitals.

"Although the law does not specify any amount of capital stock as a pre-requisite to admission to this State, it is desirable that fire companies which do not possess an unimpaired capital of at least one hundred thousand dollars, postpone their application until they are able to show this amount in undoubted securities."

Taxes on Gross Premiums.

"After the close of each year, and in the month of January of the succeeding year, companies are required to report to the commissioner, under oath of the president or secretary, the entire amount of premiums of every character and description received in this State during the year preceding, and to pay a tax of three per cent. thereon."

Penalties.

There attaches a penalty of $500 for each month, or fraction thereof, during which any company, or person acting for any company, receives premiums or forwards applications, or in any other way transacts business in this State for an unauthorized insurance company. A company which has been authorized, but neglects to file its annual statement by the required time, will be prohibited from doing *new* business within the State. Certificate of authority cannot be renewed when a company fails to pay the three per cent. tax on the premiums of the previous year.

Fees.

Filing charter, $25; filing annual statement, $20; annual certificate of authorization, $2; agent's annual certificate, $1.

——For twenty-six years the Penn Mutual Life Insurance Company of Philadelphia has performed the functions and discharged the duties of a life office. Before a generation of men it has done its work, underwent the inspection of inquirers, the criticisms of the censorious, the aspersions of opponents—moving in its own way, it has gone through these years of trial without failure in any essential thing, without coming short of a rigid standard of responsibility; and to-day the united testimony of all informed on the subject is, that the Penn Life is up to all the requirements of the time, and fulfills all the conditions which practice and study of life insurance have shown to be needful and advantageous. Profiting by experience, it does not blindly adhere to past rules. Exacting where the security of the interests entrusted to its charge impels it to be so, no office is better imbued with the spirit of justice and equity. It has dispensed life insurance upon terms most favorable to its policyholders, and its returns to them have been bountiful.

A conspicuous characteristic of this company has been a judicious, faithful, and successful administration of its financial affairs. It closed the year 1873 with $4,411,026.96 of assets, whose market value, at a time when general securities were depressed in price, was in excess of what was paid for them. Despite of a large share of maturing contracts, its interest earnings keep well up to the loss payments. The accumulations, so far, are a large percentage of amount at risk, with new business gaining in ratio upon the old. The Penn Life is not solicitous to have its matured liability judged by a depreciating standard, but meets the requirements of a 4 per cent. interest valuation of policies, and by this rule shows a surplus of $364,799.49 after provision is made for the payment of $353,770 of dividends to policyholders outstanding, and the discharge of other liabilities.

Last year the Penn Life issued 1,410 new policies, insuring $4,086,473, being 630 new policies more than the issue of 1872, with $1,779,933 more of insurance—a ratio of increase remarkable, recalling the progress of the most favorable years of life insurance, and evidencing that the company has entered upon a new era of prosperity.

The board of trustees bear testimony to the efficiency of the official management by the selection, January 13th, of the old officers; not the least of whose merits was the small percentage of official expense with which the success of 1873 was accomplished.

——Virginia is beginning to see the effect of her law requiring a State deposit from non-State companies of from $10,000 to $50,000, according to capital; and the Baltimore Underwriter is informed, upon good authority, that an earnest effort will be made at the present session of the legislature to repeal the mistaken enactment. As a piece of barbarism, originating in ignorance of the insurance business, such a measure, as a supposed precaution for security, has long since been held unworthy of thought by all intelligent men at all acquainted with the subject. Essentially nothing but hostility against corporations not created by the State, provoking and multplying retaliatory State legislation elsewhere, a commonwealth following such a rule, finds, in the end, that it is legislating against itself, and crippling its own insurance resources. With most States grasping each a certain percentage of a company's capital, a certain number of States would clutch the whole capital; so the business is repressed by artificial limits. Virginia wants capital, and she repels it. She wants insurance security, and demands a special fund of ten or a few more thousand dollars (which, as a security, is scarcely a joke); she needs that her own insurance companies grow up into the requisite strength, and she passes a law to prevent them. Non-Virginia companies comply with the deposit law, in so far as they regard it as an insignificant affair; if it were a matter of moment, they would reject a business hampered with such a condition. But with Virginia companies compelled to pay the penalty of such a Virginia law in every other State they enter to do business, the matter is serious; hence, at the capitol of Virginia, the little inconsistency of prohibiting home companies from going abroad to do business while admitting companies from abroad to do business in the State, will be considered.

——WITH the dawn of the new year the United States Life Insurance Company of New York, punctual as usual, rendered its account for the year which had just closed—the twenty-fourth of the company's existence. The United States is a well-defined and established office, with a distinct individuality. There is nothing that is conjectural about it—little that is fluctuating. It goes on from year to year in its normal way, bearing the impress of the permanent and the abiding, moved in the least degree by the outward disturbances. It solidifies into strength, grows compactly rather than broadly; therefore its statement for 1873—a severe trial year for the life interest—is simply characteristic; yet, while it exhibits no marked changes, is suggestive all through of life insurance at its best. The net result of the year brings the insurances up to $23,003,316, with 10,165 policies, and augments the assets to $4,219,813.68—the latter increasing over half a million in the last two years. In the assets there are over four millions of interest earning securities, and the rate of interest received on the average assets of the year was 6.4 per cent. While the American life insurance mortality advances in higher ratios, the interest receipts of the United States continue to exceed the death claims. The annual premium income, which first passed a million in 1872, still grows. Again, a sum equal to a large portion of the premium income of the year was returned to policyholders for dividends, losses, &c. (nearly 70 per cent. in 1873); the dividend returns again exceeding the loss payments, and, after making for the last year asset provision to meet the augmenting demands of a reserve increasing by the most rigid standard, there still remains a surplus for distribution among the policyholders.

The remarkable steady working of the United States, its strong accumulative power financially, the absence of any sign of weakness, the results it makes for the policyholder, commends this company to public confidence and acceptance more than double its asset figures could do. There is evidence that it can hold its ground, whatever failures elsewhere may occur. It begins the year 1874 with a surplus, as regards policyholders, of $917,443.46, according to the New York State standard, after providing for the last possible liability, including lapsed policies.

——FOR 1873 the fire statistics show that, as a rule, the large cities had in the year something below the average of fire loss, while villages and small manufacturing and other towns came in for an unusually large proportion of fire destruction, including incendiarism. The fire insurance business of Philadelphia was profitable in 1873, the aggregate loss being exceptionally small—small enough to suggest caution, and the anticipation that Philadelphia may have another flame story in 1874. Like the seasons, fires in Philadelphia go from one extreme to another. The fire patrol of Philadelphia reports:—

	1873.	1872.
Total insurance on damaged personal property	$3,275,211 22	$6,188,227 80
Total loss on personal property	707,989 02	1,560,969 88
Total insurance on damaged buildings	1,789,886 55	2,281,009 16
Total loss on buildings	243,534 02	610,170 65

Total fires, losses, and insurances, during the last four years:—

Years.	*No. of Fires.*	*Losses.*	*Insurances.*
1870	574	$2,002,043 00	$7,683,028 00
1871	529	1,314,432 00	5,079,434 00
1872	655	2,171,141 53	8,469,236 96
1873	883	951,523 04	5,065,097 77

The small average loss per fire in 1873 is creditable to the firemen and the salvage corps.

——WITH monthly statements the Atlantic and Pacific Insurance Company of Chicago has announced the progress of its financial construction. The exhibit for January 1, 1874, shows the final payment, in December, on the subscribed capital, bringing the full paid-up capital stock to $224,500.00. The asset list foots up $330,144.30, being a surplus of $105,644.30 over capital. The mayor of Chicago, bankers and merchants of the city, speaking from personal acquaintance with officers and stockholders, endorse this company and its management. It has been able to respond to the requirements of the laws of the various States, in 26 of which it is duly authorized to transact business. The business of the company is growing, and is in small lines widely distributed. Mr. H. Prindle is manager of the Eastern department.

——THE Index gives $3,083,100 as the total premium on fire risks written in the city of Boston during the year ended August 31, 1873, viz.: Boston companies, $506,894; agencies, $2,576,206. In some cases, however, the report is for six months only. The largest business is done by the Royal, the next by the Insurance Company of North America.

On the first of January, 1873, says the Index, the only existing Boston joint-stock fire companies organized prior to the fire of November, 1872, were the American, organized 1818, and the Faneuil Hall and the New England, organized March, 1872. From the date of the fire to the 15th of February of last year, there had been organized ten other joint-stock fire companies. There had also been organized two mutuals, with paid-up guarantee funds. The total paid-up capital of the Boston joint-stock fire companies is now $3,500,000. This, the guarantee funds of the two mutuals above referred to, increases to $4,200,000. This is an average of but $280,000 each. Such, then, is the capital which the wealthy city of Boston has invested in fire insurance. It seems hardly necessary for us io say that it is wofully insufficient. During the year ending August 31, 1873, considerably less than one-sixth of the Boston fire premium went to home companies. It may be claimed that business prudence helped along this result. Perhaps; but if so, there should be capital here invested which would draw from other parts of the country such a business as would counterbalance, at the least, what Boston pays out. Indeed, the flow of premiums should be towards a great commercial centre like Boston, possessed of large accumulations of capital, rather than away from her. Such, however, cannot, at least to any appreciable extent, be the case. With no company having an organized agency system, with no company of large capital, the tendency of fire premiums must be, at present, at least, from, rather than to, the city.

——THE second annual statement of the National Fire Insurance Company of Philadelphia shows an asset total of $567,980.50, January 1, 1874, an increase for the year of $143,441.88. This company's business has already attained large proportions, and the figures of its growth last year prove that the work of 1873 was done effectually, though quietly and without ostentation. Policies issued during 1872, 6,753; during 1873, 16,112; and for the current year the indications are favorable to a yet larger gain in the company's business. Mr. W. D. Halfmann, secretary, has resigned that position, though still remaining with the company as a member of its directory. Mr. H. R. Edmonds succeeds Mr. Halfmann in the secretaryship. Mr. Edmonds has been connected with the company from its beginning, and has demonstrated his qualifications for the office to which he has been promoted. He comes from Pottsville, Pa., and is well endorsed at the place of his former residence, where he was for nine years engaged in the internal revenue department as deputy assessor and collector. He was also, for five years, a member of the board of education of Pottsville, and part of the time secretary of the board. Mr. Edmonds also filled other public positions, and all with credit. Simon J. Stine, Esq., has been reëlected president. His administration has been satisfactory to the directors, and promotive of the best interests of the company.

——WITH the ultimate transfer of the assets and liabilities of the St. Louis Mutual Life to the Mound City Life, certificates of $100,000 of the increased capital of the Mound City will be issued to the stockholders of the St. Louis Mutual Life, being in substitution for the stock of the latter company.

From the contract between the two companies we make the following citation: "Said party of the first part [Mound City] does further promise, covenant, and agree, that it has now a surplus as to policyholders of at least $400,000, and will make its annual report for the year ending 1873, and file the same as required by law with the superintendent of the insurance department, and to be by him approved, exhibiting legally a surplus as to the policyholders of not less than $400,000. And said party of the second part [St. Louis Mutual] does hereby covenant that the statement made for it by Edwin W. Bryant, actuary, and others, dated October 17, 1873, is believed to be a true and fair exhibit of said second party at said day; and that said party of the second part has not disposed of any of its property since last named date, save in the legitimate transaction of its general business."

Sixty days from December 13th is the limit allowed to the Mound City to complete its stipulations as to increase of capital, &c.

——JUST now the best thing in connection with the question of the general practice of fire insurance is the answers to the Three Propositions involving co-insurance with or without the three-quarter limitation of amount insured. As the replies come in, they make a revelation of how much or how little fire underwriters know about fire insurance. An outsider would say there was a touch of malicious jesting in putting forth the three conundrums. There is a disclosure of animi, certainly not at first anticipated, but the test is valuable. Different men, of course, construe the propositions differently. Some talk well in the direction of their mental bent; others do not know what they are talking about. Some do not fear moral hazard; others regard it as the supreme evil. Some look at the question solely on the side of premium; others on the side of loss. There are those who favor co-insurance, "the average clause," exclusively for the reason that, under it, the heaviest lines can and will be written. Enemies of full insurance take to the three-quarter restriction, as, of itself, the all-sufficient remedy; while, to write the biggest amount possible, and pay the least possible absolute portion of loss, is a theory not without its attractions. It looks, however, as if the best minds of the profession either have or will give in their adherence to No. 2 of the propositions (co-insurance with three-quarter clause) as the first step in a radical reform.

——AN increased business was done by the Fame Insurance Company of Philadelphia in 1873, and with favorable results. After paying the losses by the Boston fire, there was a surplus for the year of unexpended receipts equal to nearly 20 per cent. of the income, and about $20,000 were added to the company's assets. A good name has been won by this company, and it is sustained by the prompt and proper discharge of every obligation. It is the object of no suspicion, and against it there are no accusations. Its condition is as represented, and those dealing with it have had no cause of complaint. Messrs. Richardson, Rhawn, and Blanchard have been reëlected to the positions which they have worthily filled, and their official conduct receives, as it deserves, the respect and confidence of the public.

——THE idea of early department reports for the State companies solely, is gaining ground. This reform greatly enhances the utility of the departments, and no valid objection can be made against it. The most capable and industrious of the State officials will, we feel sure, fall into the movement, if for no other purpose than that of avoiding the farce of having information due to the public at the beginning of the year appear towards the end of it. In Pennsylvania, where the newness of the department makes obstacles to speedy work, Commissioner Forster does not hesitate to come up to a requirement which the times demand; and in forwarding his statement blanks to the State companies, advises the officers thereof, that "prompt reports from the companies are necessary to insure an early report from this department showing the condition of companies of this State. It is hoped that officers of companies will give immediate attention to this duty." The life policy valuations (a prominent excuse heretofore for delay in reports) will be ready in time in Pennsylvania, and as a company with business well conducted, and its affairs in good condition, has the least impediment to an early exhibit, and the least reasons against it, such company will not fail to secure the advantage of the rising opinion that the "most prompt are the best."

——THE tendency of State legislation on insurance has been as a rule to do away with petty local restrictions. Indiana, however, sets up a county requirement, which shows great expansiveness in its commercial ideas. The attorney-general of the State has decided that the agent of a non-State company must file a sworn statement of his company with the clerk of the Circuit court of *each county* where he intends to do business before he can *legally* write a policy or collect a premium. Would it not be an improvement on this to have a sworn statement for every ten-acre field? What a nice law mess might be got up out of the underwriting, illegal by the county stamp, premium illegal, insurance illegal, and all the delightful verbiage and things thereunto attending!

——AT date of January 1, 1874, the Eastern department of the Atlantic and Pacific Insurance Company, Mr. H. Prindle, manager, had been in existence six months. In that period the net premium receipts of the department were $75,475, and not a single fire. While exemption from fire loss in the first period of a new business has not been an uncommon incident in fire insurance, recent times have not been very favorable to such desirable accidents, and we believe this exemption to be somewhat characteristic of Mr. Prindle's insurance life. At least, he can afford to invite comparison as to the whole result of his various agencies, in respect to ratio of loss to premium.

——At its inception, it was generally held, that State insurance supervision was *for* the public benefit, and *against* the ease and preferred privacy of the companies. The system, notwithstanding its many defects, appears, however, to have grown in favor with the offices The Insurance Monitor has brought the matter to a vote in submitting for answer the test question:—

> Would you, or would you not, vote for the abolition of the insurance departments of New York and Massachusetts?

The Monitor's communication was dated December 23, and, by January 1, 114 companies replied, viz.: 23 Yes, 91 No. Some voted Yes on account of the abuses. Among those voting No there was an earnest demand for reform. There were instances on each side of faith in national supervision.

——Conspicuous as being at the head of the safe deposit system of the country, the Fidelity Insurance Trust and Safe Deposit Company attracted more than ever, in 1873, national attention. The rock-like firmness with which it met the storm of the September panic, the service which it rendered to the general financial interest, will not soon be forgotten. It closed the year with its financial condition unaffected by the tumult through which it passed, showing assets increased, Jan. 13, 1874, to $7,481,005.71, and a prosperous business condition.

——The Chicago board of fire underwriters favor a revision of the schedule of additions for deficiencies from standard pork house. The standard, with items of deficiences and the charges for the latter, were accepted by the Chicago board October 30th, being prepared by the National Board committee after consultation with members of the local board. Now the Chicago board, taking the standard and the description of deficiencies, proposes to reduce rates for the latter in some instances one-third—one item to be left discretionary.

——'Longshoremen struck at the port of Philadelphia, making difficulties in the way of the safe lading of vessels. The marine underwriters had to demand proper storage of cargoes before writing on the risks; so some of the strikers had to be reëmployed. This, along with the railroad engineers' strike, brings up such combinations as a question in which public safety is involved.

——Andrew F. Hastings, receiver of the Security Fire Insurance Company of New York, petitions the Supreme court for an order to sell the uncollected debts of the company at public auction. Mr. Hastings reports that so far he has realized upon the assets of the company $1,600,000 Something over $1,800,000 was the total given of the Security's assets before the Chicago fire.

——There will possibly be two or three new fire insurance companies organized in Philadelphia under charters existing before the adoption of the new constitution. To keep sundry corporate franchises from extinction there was a lively time before the close of the year 1873 in effecting organizations, and otherwise making literal conformity to the constitutional conditions.

——The executive committee of the National board of fire underwriters rescinds the resolution charging 50 cents additional premium upon all mills using the products of petroleum as lubricators, and permits, without extra charge, the use of manufactured oils that stand a test of 250° as a flashing point, and 300° as a point of ignition.

——Boston contemplates two or three corporations in the safe deposit way, guarantee of personal fidelity, &c.

——The American Life Insurance Co. of Philadelphia, George W. Hill, Esq., president, added about half a million to its assets in 1873. For losses and endowments $447,98.25 were paid, (a less mortality than in the previous year,) and $306,743.72 of dividend were paid to policyholders.

——By a vote of 102 to 14 the Missouri house of representatives condemned the action of ex-Governor Woodson in appointing Gen. Frank P. Blair superintendent of the State insurance department. Subsequently the senate confirmed the appointment of Gen. Blair by a vote of 20 to 11.

——Philip Goldstein was sentenced to two years' imprisonment by the Supreme criminal court of Boston. Goldstein and an associate had a stock of goods worth about $800, got insurance for $10,000. Goldstein suffered for the arson; Davis, the associate of Goldstein, escaped.

——The Williamsburg City Fire Insurance Company of Brooklyn has declared a semi-annual dividend of 5 per cent.; Continental, of New York, 5 per cent.; Home, 5 per cent.; Traders' Insurance Company of Chicago, a quarterly dividend of 3 per cent.

——Against the policy of the department law, Governor Hartranft, of Pennsylvania, recommends for fire and life companies a definite amount of capital as a pre-requisite to commence business. New bill got up for this and other objects.

——The New York board of fire insurance brokers has passed a resolution to reconsider contract entered into with the board of fire underwriters, in reference to taking risks from brokers not members of the board.

——Late sales by auction of Boston insurance stocks were as follows: American, 90; Boylston, 97¼, Eliot, 95; Firemen's, 95¼; Manufacturers', 93¾; Neptune, 89¾; Shoe and Leather, 90; Washington, 90; Phœnix of Hartford, 7½ per cent.

——The Hand-in-Hand Life Insurance Company of Philadelphia still lives—in so far as to be defendant in a suit against it in District Court No. 1, Philadelphia. Verdict for plaintiff, $1,052.

——Palmer L. Jones, ex-agent at Buffalo of the Brooklyn Life, goes to the county "workhouse." Cause—retained premium collected, and forwarded forged vouchers of expenses.

——Messrs. Birckhead & Reeves, a new firm, have been appointed the Baltimore managers of the marine and fire business of the Insurance Company of North America.

——Central Fire Insurance Company of Philadelphia is the name of a new company projected by Mr. Halfmann, late secretary of the National Fire—capital, $200,000.

——A resolution, looking to an investigation into the administration of the Kentucky insurance bureau, has been introduced into the State legislature. Time.

——The house committee of the Kentucky legislature sustains Commissioner Smith in his action towards the Globe Mutual Life Insurance Company of New York.

——The combination known as the New York Underwriters' Agency has been cleft in twain, two of the companies withdrawing.

——January 7th, the Franklin Fire Insurance Company of Philadelphia declared its regular quarterly dividend—eight dollars (gold) per share.

——Sales by auction, January 14th, in New York: Stock of Resolute Fire, 65 per cent.; Mercantile Fire, 79¼; Ætna, New York, 71½.

——Mr. L. Kauffman has been appointed superintendent of agents by the National Fire, of Philadelphia.

RAILWAYS AND TRANSPORTATION.

IF the advocates of cheap transportation would confine their efforts in that direction in legitimate channels, and only seek their ends by carefully respecting vested rights, their arguments would certainly be amusing, and perhaps instructive also. The high moral tone assumed by these gentlemen, and their efforts to prove that cheap transportation is a necessity not to be measured by ordinary business rules, as is the question of cheap beef or mutton, but something of vital importance to the community, and not inferior to those affecting public health or the repression of crime, is certainly calculated to afford an unprejudiced mind food for reflection, both as to the business qualifications of the general public which is to be moved by them, and the amount of hypocrisy and selfishness latent in human nature. Most, if not all, the arguments advanced in favor of establishing, by law, rates at which railway corporations shall carry freight and passengers, that have fallen under our observation, stripped of their specious disguises, amount to simply this: The corporations are wealthy, and have constructed roads at an expense far beyond the reach of private capital, and as the shipper is not getting affluent at such rates as he would could he get transportation on his own terms, the carrying companies are to make up the deficiency. Indeed; why not go further? If States or communities may set a price upon one article or service, what reason can be advanced for not interfering in every department of business? Is there any pretence that it is the exclusive privilege of a few to build railways? Certainly not; and if railway operating is so profitable, why do not the shippers buy an interest?—there is plenty of stock to be had. Is it contended that the companies already organized control all the available routes? This could never be substantiated except in isolated instances, and is now almost unknown. Is there any obligation, moral or legal, to ride or ship goods by any particular line? Certainly not. The country is full of land and water ways which have been improved and constructed at government expense, and any person is at liberty to use them at none or merely nominal rates, and no railway corporation does or can interfere? Is there anything in the construction or business of a railway corporation which calls for outside control more than exists in every case where one or more individuals engage in any legitimate business? None appears upon the surface. A corporation is only an aggregation of individuals, pursuing a certain line of business, acknowledged to be right and proper in itself, most of whom are also engaged in other business, often of an entirely diverse character, and all of whom are quite as unselfish as those possessing no interest. Is there anything in the business of carrying which places those engaged in it under suspicion as public enemies, to be carefully watched? If so, the credit of the discovery belongs to a very recent period; for, although carriers have existed as far back as we have any tradition, the idea of putting a price upon their services, as at present understood, was entirely unknown until now. What logic or decency then is there in attempting to force a railway company to render its services at a certain price, more than in regulating the price of merchandise, or of the services of a laborer? And how can such an interference be carried out without the rankest injustice, unless the price of labor which the corporations must hire, and the merchundise they are obliged to purchase, is also regulated?

It cannot be said that a railway corporation is at liberty to refuse to carry if the price is not remunerative, for they are obliged to take all that is offered in a proper manner; and if this were not so, their property is of the most unportable nature and worthless unless fully employed. These gentlemen are also attempting, notwithstanding the universal failure which has always attended the efforts of governments to manage railways, and their sad effects upon public morals, to involve both the State and General governments in new schemes for the construction and operation of certain trunk lines for the avowed purpose of cheapening transportation between the West and the seaboard. Such an attempt on the part of private individuals, in which anyone would be at liberty to take an interest or refuse, would be entirely unobjectionable. In its present aspect, however, leaving out the utter inability of municipal bodies to manage a business of this nature, and the demoralizing effect such matters have when introduced into a legislative body, there is something so unjust in a scheme for taxing the many for the benefit of a few, and forcing existing business to contribute towards constructing a rival avowedly intended to injure it, that it ought not to be allowed. The more prominent of these schemes is one for a "New York and Chicago Postal Railway and Telegraph Company," for the incorporation of which Senator Logan introduced a bill in congress early in the present session. How the proposed road is to effect its object has not transpired, nor can an ordinary mind reasoning from the past experience of private corporations ascertain. The proposed capital is to be $100,000,000, rather more than $110,000 per mile, considerably larger than the capital account of any line already built, and there is nothing especially perfect or costly in the proposed construction. The rates for the carriage of freight and passengers, too, are or may be higher than are the present rates on the lines already constructed—that for the carriage of wheat being 38 cents per bushel, or rather more than double the summer rates by water. The clause in the proposed charter allowing materials which are to enter into the construction of this road to enter free of duty, is of a character quite in keeping with the gross injustice of the entire conception, and ought, and no doubt will, insure its defeat. Indeed, there may be a question whether, in the present temper of congress, the bill could be passed if shorn of this most unjust provision.

——A SINGULAR commentary on the claimed superiority of British railways and their management is furnished by the recent circular of Mr. Chichester Fortescue, president of the board of trade, to the railway presidents of the United Kingdom. He desires "to call their attention to his official report of the accidents which occurred during the year 1872, as exhibiting an undesirable state of affairs, and further believes that the same causes of accidents have not only been continued but aggravated during the present year. It appears," he says, "that a large proportion of the casualties are due to causes which are within the control of the railway companies." He asserts that there can be no doubt that methods of working and mechanical contrivances, the value of which have been thoroughly ascertained, have been too slowly introduced, and fears that sufficient provision has not been made for the increased traffic by enlarging depots and increasing the number of tracks. He also calls attention to the frequent unpunctuality of passenger trains both as a breach of the companies' duties and of their contract with the travelling public, and also as a fruitful source of accidents and loss of life, and to the lamentable number of employés annually injured, and intimates that their position is not rendered as secure as it might be by proper accommodations and appliances. As the board of trade is a department in the cabinet of the United Kingdom, this circular will be apt to be heeded by those to whom it is addressed, and the public will unquestionably be the gainer in consequence. It is certainly a long stride in the direction of reform that an official in Mr. Fortescue's position has had the hardihood to point out so clearly to the companies themselves faults in management which have been apparent for a long time to every one else.

——CONTRARY to general expectation, and, we believe, contrary to all precedent also, one of the railway companies which defaulted the payment of interest on its bonds, November 1st, has made arrangements to pay the defaulted interest January 15th. The company which has taken action so much out of the usual course is the St. Louis and Southeastern, and, we believe, is the first and we fear the only one thus to offend the proprieties. The company announces that the coupons of the Evansville, Henderson, and Nashville bonds, due January 1st, will be postponed until March 1st, and those of its consolidated first mortgage bonds, due February 1st, until April 1st, paying interest upon the coupons in each case at the rate of 7 per cent. per annum.

——A MOVEMENT, intended to settle the outstanding claims of the State of Louisiana against the New Orleans, Mobile, and Texas railroad, and initiate a progressive policy, has begun. In June last, a second mortgage on that part of the line between Mobile and the Mississippi river was foreclosed, and the property sold and purchased by the bondholders, who organized a new company; and now Mr. Frank M. Ames, trustee under the first mortgage, has filed a bill in the United States Circuit court at New Orleans, for the purpose of foreclosing a first mortgage and selling the line west of the Mississippi river. The complaint states that first mortgage bonds to the amount of $7,250,000 were sold, and that two coupons upon them, due January 1st and July 1st, 1873, are unpaid. There were also disposed of, bonds, indorsed by the State of Louisiana, amounting to $4,125,000, making a total of $11,375,000, on account of building this road to Houston, Texas. The trustee, while not claiming any further guarantee from the State of Louisiana, does claim the right to demand a further issue of $750,000 subsidy bonds from the State, "when the line shall have been completed to Vermillionville," which requires only the purchase and laying of the iron, and prays the court for permission to do this.

The defendants named in the bill are the New Orleans, Mobile, and Texas Railroad Company, the New Orleans and Texas Railroad Company, and Governor W. P. Kellogg. The former two have filed their answer, admitting all that is charged in the bill, and the trustee now earnestly desires that the governor shall do likewise, but he has not yet done so; and as it is believed that the legal effect of such an admission on his part will be to release all claims of the State against the old company, and confirm the validity of the bonds issued and guaranteed by the State, and deprives it of all claims against the road, his hesitation is perhaps commendable, although it is hard to see how the admission of one person could have so sweeping an effect against any one but himself.

——A DISTURBING incident at the close of the year was the strike of the locomotive runners on the leased lines of the Pennsylvania railroad west of Pittsburgh. It, however, soon ended, as most strikes seem fated to end, in such of the men as could get employment returning to work at reduced rates. The cause assigned by the engineers was, we believe, the attempt on the part of the companies to reduce their wages; but as the salary of nearly every other employé had also been reduced, and necessarily so from the limited business offering, the companies could not in common justice do otherwise. The engineers soon saw that there were two sides to this question, as is usually the case, better councils prevailed, and the strike ended before it had fairly begun. There was considerable excitement on other roads, especially the Pennsylvania, but no strike; although, had the strikers on the western roads held out a few days longer, it is probable that the movement would have been more widespread, and hence more disastrous to both parties. The Brotherhood of Locomotive Engineers did not, openly at least, favor the strike, and the president of that society emphatically asserted that it was unauthorized. The constitution of the society is, we believe, not essentially different from that of most others, being composed of a central organization, with numerous subordinate divisions, all working under a single constitution and code of laws. The mode of procedure, in case a body of workmen feel themselves aggrieved by any action of their employers, is to put themselves in communication with all other divisions through the central authority, and no strike is lawful until a majority of the other divisions have signified their approval. Such a course must take time, and, as those divisions which vote to sustain the strike are bound to support it by contributions, they will not be very apt to approve on slight grounds. It seems probable that this action was the impulse of only a few without waiting for authority or consultation. Indeed, it may be doubted whether any strike will be authorized by the society under its rules, unless a case of extreme hardship occurs, and in this view the brotherhood will, if its rules are obeyed, prove a positive benefit both to employer and employed.

——AT a special meeting of the directors of the Poughkeepsie and Hudson River Bridge Company, held lately, Mr. J. H. Linville, president of the Keystone Bridge Company, was appointed chief engineer, and Mr. J. Edgar Thomson consulting engineer. The plans of Mr. Linville, as to approaches, &c., were adopted. The bridge will be an immense structure, as in addition to crossing the river, it will also be carried over a considerable part of the town, spanning the streets upon arches of various dimensions. In accordance with the charter, four river piers will be constructed 500 feet apart, in addition to the one on each shore, the top of which will be 130 feet above high-water mark, and upon these will be laid the iron and steel trusses, 70 feet high, upon the top of which the trunk will be laid, thus making the elevation 200 feet above the water. Commencement of the work was ordered at once. The authorized capital of the company is $2,000,000, of which amount $1,250,000 have been subscribed, and the balance is expected to be obtained from the friends of the Pennsylvania, Reading, Erie, and Poughkeepsie and Eastern railroads. All these companies, except the Erie, are stockholders, and that company is expected to come in, as from its location and connection it has nearly as much interest in a short route to the Eastern States as any of the others. The bridge is expected to cost from $4,000,000 to $5,000,000. The directors are: A. L. Dennis, president; George Innes, G. P. Pelton, H. G. Eastman, P. P. Dickinson, Thos. A. Scott, J. Edgar Thomson, J. McCandless, Mr. Knears, Chas. G. Franklyn, and D. Solomons.

——AT the close of the war the government held a large quantity of rolling stock and railway material in different parts of the South, and as the best that could be done sold it to the different companies on credit. The several railroad companies in that section being in various degrees of dilapidation and insolvency, not to be wondered at under the circumstances, were happy to get anything on credit, and have displayed commendable energy and honesty in endeavoring, more or less successfully, to pay off the debt thus assumed. The total collections by the government to June 30, 1873, amount to $5,116,605.53, leaving still due $4,558,924.07. The number of railroads originally indebted was sixty. June 30, 1872, this number had been reduced by various means, though principally by payment, we believe, to twenty, and five of these had managed to liquidate their indebtedness to the government by July 1, 1873, leaving fifteen yet on the list, most of which have reduced their indebtedness during the past three years materially. Upon the whole, the outlook for Southern roads in the matter of this indebtedness is very promising, and much commendation is due them for the energy displayed in this regard. Should the bill introduced by Senator Alcorn, authorizing the secretary of war to compromise these claims upon equitable terms become a law, the prospects are favorable for settling the entire indebtedness by July next.

——THE following is understood to be the modified proposition for funding the coupons submitted to the holders of the bonds of the Chesapeake and Ohio Railroad Company: 1. The coupons to be surrendered and the assignments of registered interest shall be placed in the custody [illegible] banking or trust company acceptable to a majority in interest, to be held in *escrow* for five years from January 1, 1874 2 If, during that period, there shall occur a foreclosure of either of the mortgages on the road, then the coupons and interest assigned that are secured by that mortgage shall be entitled to the priorities established by the mortgage, after deducting whatever may have been paid as interest on the income bonds. 3. Interest paid at any time on the income bonds shall cancel an equal amount of the coupons and assignments held in *escrow*. These modifications are understood to be favorable to the bondholders.

——CHICAGO, by the completion of the railway ferry at Cairo, and of the road between that place and Jackson, Tenn., 106 miles in length, has been for some weeks in all rail connection with New Orleans. The distance is 912 miles, about the same as to New York, and the line is composed of the Illinois Central, Mississippi Central, and the New Orleans, Jackson, and Great Northern railroads. These roads will be managed as one corporation—the Illinois Central having guaranteed the McComb bonds to the amount of $6,000,000, by means of which the new road has been built and the old ones refitted. The time between the cities is 39 hours; and, as the arrangement is to start two trains a week, the managers evidently believe in commencing, as they can continue without straining new machinery.

——BOURBON county, Kansas, in 1871, issued $150,000 in bonds in aid of the Tebo and Neosho (now a part of the Missouri, Kansas, and Texas) railroad; and now the Supreme court of that State declares the issue illegal and bonds void, from the fact that the order for the election did not name the road to which aid was to be voted, and also that the vote was against the issue. The United States Circuit court has decided that the bonds issued in aid of the same road by Vernon county, Missouri, are legal and valid.

PATENTS, ARTS, AND SCIENCE.

[This Department is under the editorial charge of WILLIAM H. WAHL, Ph. D.]

PRICES of American irons, pig and manufactured, continue to show some advance, though generally from other causes than active demand. Few pig-iron makers are offering to sell for future deliveries, there being some anticipation of a further upward movement in rates. Shipments of Scotch pig show a considerable falling off in December as compared with same month last year, but arrivals at New York have been placed in yard to avoid pressure on the market Abroad, a lower range of rates is looked for.

Rails and bar are still offered on unremunerative terms. Trade in old rails has become exceedingly limited.

December–January Iron Report.

	27th.	3d.	10th.	17th.
AMERICAN FOUNDRY PIG:—				
Lehigh, No. 1	$35.00	$35.00	$36.00	$36.00
" No. 2	33.00	33.00	34.00	34.00
" " (plain)	31.00	31.00	32.00	32.00
" No. 3 (gray forge)	29.00	29.00	30.00	30.00
" No. 4 (mottled)	28.00	28.00	29.00	29.00
" White	27.00	27.00	28.00	28.00
Schuylkill, No. 1	34.00	34.00	35.00	35.00
" No. 2	32.00	32.00	33.00	33.00
" Gray forge	27.00	27.00	28.00	28.00
" Mottled	26.00	26.00	27.00	27.00
" White	25.00	25.00	26.00	26.00
SCOTCH PIG:—				
Gartsherrie	43.53	44.10	44.41	44.06
Coltness	43.93	44.49	44.81	44.73
Summerlee	43.27	43.83	44.14	44.06
Langloan	43.27	43.83	44.14	44.06
Calder	43.27	43.83	44.14	44.06
Carnbroe	42.48	43.04	43.47	43.38
Glengarnock	42.48	43.04	43.47	43.38
Eglinton	41.82	42.38	42.80	42.71
Dalmellington	41.82	42.38	42.80	42.71
Old rails, D.H.'s	40.00	41.00	41.50	41.50
" T's	39.50	40.00	40.50	40.50
English rails (ex. ship.)	67.00	68.00	69.00	69.00
American rails (manufact'd in Penna.)	66.00	67.00	68.00	68.00
No. 1 Wrought scrap	40.00	41.00	42.00	42.00
Cast scrap (machinery)	26.00	27.00	28.00	28.00
Stove-plate scrap	23.00	24.00	25.00	25.00
Wrought turnings	24.00	25.00	26.00	26.00
Cast "	20.00	21.00	22.00	22.00
American refined bar	$3\frac{1}{10}$c.	$3\frac{1}{10}$c.	$3\frac{2}{10}$c.	$3\frac{2}{10}$c.
" common bar	62.00	62.00	63.00	63.00
Railroad spikes	.04	.04	.04	.04
Nails (℘ keg)	4.50	4.50	4.50	4.50
Street rails (deliv'd on car, Broad & Willow)	71.00	71.00	71.00	71.50

——Our foreign contemporaries are just now much engaged in discussing the possibilities of the novel invention of Gen. Tilghman, of Philadelphia, for engraving and cutting stone, glass, and other hard substances, with the sand-blast, which has attracted so much attention in this country since the time of its first public announcement at the meeting of the Franklin Institute in March, 1871. The invention in question, from its novelty, the beauty of its results, and especially from its wide range of application in the useful and decorative arts, has everywhere elicited comment and admiration. We have, in previous issues of the Review, described many of the effects produced through its instrumentality, but have not given the mechanical details of the machinery and appliances required in its operation. The exhibition of the sand-blast at Vienna and at the London International exhibition affords the opportunity for giving such a description of this portion of the process as will fully do justice to the newest developments of the invention.

There are two machines in operation in London, upon glass, and one upon stone. The small machine is to all appearance a very plain painted box or stand—none of the machinery being visible. In the top of this box are two holes, about an inch and a half in diameter. If the wooden casings were removed, there might be seen below these holes a pipe, which descends, and is formed somewhat trumpet-mouthed on the outside of the bottom of the box. Below this mouth is a turned wooden basin. From the upper part of the box, on the spectator's left hand, a pipe passes underneath the floor to the centre of a rotating fan, near the wall of the room, by which arrangement it is possible to produce a vacuum in the box. As the only inlet of air is past the trumpet-mouthed opening, a rapid current ascends the pipe connected with it, whenever the exhaust fan is at work. From large hoppers (funnel shaped) containing sand, a regulated quantity falls towards the turned wooden basin. In falling on the basin it is influenced by the entering air, is jetted from the pipe, and so strikes upon, say glass covering the holes, when the exposed glass will be rapidly depolished. Where, however, an elastic substance—as paper, India-rubber, etc.—covers the glass, as we have remarked in former notices, there no action of the sand takes place; and if interstices or openings be formed in this elastic substance, as a pattern, then the surface of the glass is removed in accordance with such pattern, and to a depth dependent upon the time of exposure, the intensity of the current of air, and quality of sand.

Besides this small "vacuum" machine, Mr. Tilghman has in operation a large compressed air-blast—one capable of acting upon a sheet of glass three feet broad. A design on paper or lace being pasted on the glass, it is laid upon endless bands, by the motion of which it may be carried forward. In the middle of the compartment (which is glazed upon one side so that spectators may see the operation), provision is made, by a suitably formed transverse opening, for a blast of air with sand. When the ordinary machinery is set in motion, this blast commences, the glass is traversed at a prearranged velocity, and in as little time as one may require to read this account the ornamented glass is delivered at the side of the box opposite to that at which it entered.

The third machine is in a separate building. It consists of a wooden table, on which the stone is laid. This table can be traversed impulsively in one direction by the action of a Clement's driver, on a spur-wheel, and so motion is given to a rack. Above the table provision is made for traversing the combined steam and sand jet. This is accomplished by a mangle-wheel motion, variable according to the breadth of the stone to be operated upon. By the combination of these two motions—transverse to each other—every portion of the stone can be reached. The steam and sand jet is arranged upon the plan adopted by Mr. Siemens for exhausting the telegraph dispatch tubes—the sand being admitted by an inner small tube, surrounded by jets of steam, as from concentric rays of an Argand burner.

——From the American Gas Light Journal, we learn that a British patent has recently been granted to A. M. Webber for a method and apparatus for obtaining photometric measurements in terms of electrical measurements. A body, of which the electrical conductivity or resistance is altered by exposure to light, is placed in an electrical circuit, in which circuit is also placed an electrometer, or guage of electrical resistance. Light is directed on the body, and the value of this light, or the transparency or density of any translucent substance through which the light is passed, is tested by the effect on the electrometer or resistance guage.

——We have referred to the results of experimental trials with the new alloy, phosphor-bronze. We observed that the phosphor-bronze had been employed to advantage for the great bearings of the plates in general rolling mills, and for conical gearing in universal rolling mills, in cases where the rollers weighed five tons. It was found that the gear, when made of hard cast-iron, broke frequently; this was replaced by wheels of ordinary bronze, and finally by wheels of phosphor-bronze. The duration of ordinary bronze wheels did not exceed, on an average, five months, while those made of the phosphor-bronze lasted for about nine months. The phosphor-bronze has also been applied not only in the making of pinions, but in the driving axles of mills; in the latter case the superiority seeming to depend not on the hardness, but upon the very great resistance of the alloy. To form a just idea of the value of this remarkable substance, no better evidence could be offered than the estimate placed upon it by the several juries in the mechanical department of the Vienna exposition, where it obtained the following awards, viz.: In group 1, for cog-wheels, tuyeres, and bearings, the diploma of merit; in group 7, for revolvers and parts of harness, the medal of progress; and in group 12, for its application to guns and other material, the medal of merit. Unlike other alloys, it can be remelted without any material loss or deterioration of quality; while heavy steel castings, on the other hand, when worn out or broken, are comparatively worthless. A great variety of objects hitherto worked in iron and steel, may now be cast in phosphor-bronze with advantage, and in many cases they require only a polish to make them ready for use; in addition to which they possess the merit of not corroding. Its great fluidity, compactness, and fine grain, as likewise its beautiful color, are qualifications which adapt it eminently for decorative art, and the perfection of the castings, materially reduces the cost of subsequent chasing and finishing. The phosphor-bronze allovs made for rolling, drawing, or embossing, will stretch more than copper, or any of its ordinary compounds. Plates have been reduced by a single cold rolling to one-fifth of their thickness, the edges remaining perfectly sound and without crack. Another advantageous property of the new alloy resides in its incapacity to emit sparks. Tools, knives, scissors, and other articles, such as locks, keys, &c., have on this account already been largely adopted by manufacturers of gunpowder.

Several governments have experimented on the new alloy as to its adaptability for making cannon. Without exception the result showed a much greater resisting power than that displayed by ordinary bronze. In Prussia it was shown, in firing with the regulation charges, and diminishing at each fifty shots the exterior diameter of the chamber, that the phosphor-bronze cannons changed their dimensions only when the thickness of the metal was below that of the dimension of a cannon of the same calibre of steel. The Belgian government has adopted the phosphor-bronze for small arms and for the harness metal of its cavalry. From the brief space of time it has been before the mechanical world, not less than from the modifications of which its physical properties are susceptible by slight variations in its constitution, it is fair to presume that the uses to which it may be advantageously applied have as yet by no means been fully recognized.

——A NOVEL and simple electrical light has been suggested by Dr. Geissler, whose name is so intimately associated with some of the most beautiful experiments that can be performed by electricity—the plan being to make an electrical vacuum tube that may be illuminated without the employment either of the inductorium or the frictional machine. It consists of a tube an inch or more in diameter, filled with air as dry as can be obtained, and hermetically sealed after the introduction of a smaller exhausted tube. If this outer tube be rubbed with a piece of flannel, or any of the furs generally used for exciting the electrophorus, the inner tube will be illuminated with flashes of mellow light. The light is faint at first, but gradually becomes bright and softer. It is momentary in duration, but, if the tube be rapidly frictioned, the light is rendered apparently continuous upon the principle of the persistence of vision. If the operator have at his disposal a piece of vulcanite previously excited, he may, after educing signs of electrical excitement within the tube, entirely dispense with the use of flannel or fur. This will be found to minister very much to his personal comfort. He may continue the experiments, and with enhanced effect, by moving the sheet of vulcanite rapidly up and down at a slight distance from the tube. The phenomenon here described is explained to be an effect of induction.

——OUR English contemporaries are still engaged in discussing the problem of the Anglo-French tunnel to connect England with the continent. The last meeting of the Civil Engineers' Society was devoted to the reading and discussion of a paper upon the geological aspects of the problem presented by Mr. Joseph Prestwich. The object of the paper was to demonstrate that there were sufficient reasons for the supposition that the dense, impermeable stratum, known as the London clay, extends in a continous trough, from 300 to 400 feet or more in thickness, from the coast of Essex to that of Belgium. The author of the paper declares it as his opinion that there are no difficulties from a geological standpoint in the construction of a tunnel between these two points, save that of the extreme distance—eighty miles—between them. Where the coasts approach each other more closely—the author continues—this clay is absent, and the tertiary and secondary strata there existing are too permeable for tunnel work. These strata are, however, underlaid by primitive rocks, through which, in his opinion, it is quite possible to drive a tunnel, so far as the influx of the sea is concerned. Here, however, the great depth—1,000 or more feet—is a great difficulty. The author's summary finally asserts that, on geological grounds alone, the work is in one case perfectly practicable, and in one or two others possibly so. The gravest objections to the undertaking are, however, the engineering difficulties, which are not touched upon in the paper here noticed, but which were fully discussed at the meeting of the society, concerning which the Engineer remarks, that "the members of the Institution of Civil Engineers deserve thanks for the energy which they have displayed in dispersing the channel tunnel delusion. In the discussion of Mr. Prestwich's paper there was remarkable uniformity of opinion as to the probable impracticability of carrying out the scheme at all. There is, as we have often pointed out, a fatal objection to the tunnel, which is, that under no conceivable circumstances could it be made to pay. Assuming that the cost of a tunnel would be only ten millions sterling—and it would from first to last cost at least three times that sum—it would require a gross traffic of £1,200,000 a year to make it pay commercially, or £824 per mile per week. The largest known traffic—that on the Metropolitan Railway—realizes £1,000 per mile, so that the traffic between Dover and Calais must be as busy as that of London itself to make any tunnel answer."

After comparing the prospective tunnel business with that of other railways doing immense traffic, and estimating how much greater than these that of the tunnel must be to pay a dividend, the same journal emphatically concludes: "Of course, it may be argued, that the question is national; but we are at a loss to see why nations should be called upon to carry out undertakings which must prove failures in a commercial sense."

——THE Gloucester iron-work have lately completed a novel construction in the way of a four-ton locomotive, designed to run upon a single track. The engine in question has two driving wheels—one behind the other—and might with propriety be styled a steam-velocipede. It was built for the "prismoid, or one-track railway," of Atlanta, Georgia, where the invention has been adopted. The track upon which the engine and cars run is composed of a series of boards nailed together edgewise, in such a manner as to break joints; the whole forming a pyramid, surmounted at the top with a flat rail, and supported upon posts or pillars of wood, at any desirable height above the ground. In the city of Atlanta this height is specified to be not less than twelve feet. The permanent way, in the words of the inventor, resembles the inverted keel of a vessel, with a flat rail at the apex. It is claimed for the invention, among other things, that it has solved the problem of rapid transit in and between cities and suburbs, and of rapid canal traffic. The engine is at present on exhibition in the large building known as the Rink, in Philadelphia, where it is in daily operation upon a track erected therein for that purpose.

——THE *Polyt. Centralbl.* is responsible for the assertion that iron pyrites may be so perfectly roasted as to retain only from one to two thousandths of sulphur, by roasting the ore after having passed it once through Perret's roasting furnace, a second time in a part of the same furnace, where there is fresh ore above and below it, which furnishes a high temperature in roasting. At the same time much more air must be given access to the ore than in the first roasting. From the residue of the second roasting, it is said, a cast iron can be made, which is fit for use in the rolling mill.

——MR. R. L. HASWELL, in a recent paper, before the Austrian Engineers' Society, discusses the question of the use of steel for boilers. He remarked that the accidents which had occurred on railways using locomotive boilers of steel had thus far been only ascribed to the material; yet this was due, on the one hand, to the prepartory working of the plates, and on the other, to the small thickness, as well as to the insufficient mode of assorting them before they were used. The author only knew of five instances where such boilers got cracks, four of which occurred in the fire-box plate, and one in the cylindrical part. Haswell ascribes their faulty condition to the fact that they were rolled when too warm. Such faults, occurring even in the best establishments, indicate, according to the author, the necessity of subjecting all such material to tests for its tensile strength before using it—a course which the Austrian State railway has for some time adopted. This course has been found of great service in securing uniform strength and excellence of construction.

The following advice is offered by the author with reference to the requirements of practice:—In order to obtain steel boilers answering all requirements, only correspondingly thick plates, and plates of the best material, without any addition, should be used—for, otherwise, the steel is not homogeneous; they ought to be scrupulously assorted according to the texture and tensile strength. After boring or punching, they should be carefully annealed; the rivetting must be performed with pedantic care, and the bending only with wooden hammers. Steel plates are preferable to iron plates, owing to the fact that they possess the same degree of elasticity (from 12 to 15 per cent.) in all directions; in iron plates it is in the direction of the fibres, and, according to Kirkaldy, about 15 per cent., but in a cross direction only about 5 per cent. If one proceeds in the manner indicated, says Haswell, steel plates may be used with perfect safety.

The boiler manufacturer has the advantage that he finds less plates to throw aside, and the railway, on the other hand, will have more carefully constructed, stronger, and, in the end, cheaper boilers.

——CONCERNING the formation of deposits in boiler flues, about which a considerable amount of speculation has been published, Prof. Hayes gives the following opinion in a late issue of the American Chemist: These are of two kinds, both of which are capable of corroding the iron rapidly, especially when the boilers are heated and in operation. The most common one consists of soot (nearly pure carbon) saturated with pyroligneous acid, and contains a large proportion of iron if the deposit is an old one, or very little iron if the deposit has been recently formed. The other has a basis of soot and fine coal ashes (silicate of alumina) filled with sulphur acids, and containing more or less iron, the quantity depending upon the age of the deposit. The pyroligneous deposits are always caused by want of judgment in kindling and managing the fires. The boilers being cold, the fires are generally started with wood; pyroligneous acid then distils over into the tubes, and collecting with the soot already there from the first kindling fires, forms the nucleus for the deposit, which soon becomes permanent and more dangerous every time wood is used in the fireplace afterwards. The sulphur acid deposits derive their sulphur from the coals used; but the base, holding their acids, is at first occasioned by cleaning or shaking the grates, soon after adding fresh charges of coal. Fine ashes are thus driven into the flues at the opportune moment for them to become absorbents for the sulphur compounds distilling from the coals, and the corrosion of the iron follows rapidly after the formation of these deposits.

——A SUGGESTION of Dr. Schuppert, of New Orleans, for the purpose of extinguishing fires on shipboard, seems practical enough to warrant reproduction. According to his plan there are to be placed at given points in the hold of the vessel, boxes furnished with a supply of marble waste. Each box is to be brought into communication with the deck of the vessel by means of lead pipes, terminating in a funnel or other convenient attachment. Should a fire be discovered in the hold, sulphuric acid is poured down the pipes; and this, coming in contact with the marble, causes the active evolution of carbonic acid gas, which finds its way in quantity into the hold, through perforations in the boxes, surrounding the cargo with an atmosphere which is a non-supporter of combustion. As the carbonic acid gas is much heavier than the air, it is anticipated that it will not escape in any considerable quantity until the hold is filled to overflowing.

——REFERRING to the subject of heating the retorts of gas-works with the coal-tar refuse, a subject which has called forth a variety of opinions upon the efficiency and economy of several plans applied to this purpose, Mr. James Sommerville communicates to the American Gas Light Journal the following interesting statement of his experience in the matter: The plans of which the writer had charge consisted of two benches of fives (clay) heated with tar. No difficulty whatever was experienced in regulating the flow of the material, which ran in a fine, thin stream, being kept quite liquid from the heat of the benches; and he considers the employment of special apparatus for this purpose unnecessary. Much difficulty, however, was experienced in keeping up a steady heat in the benches, which, in spite of great attention and care in increasing or diminishing the size of the air-aperture, could not be regulated with satisfaction. The opinion which the writer ventures as the result of his experience, is, that the tar will not give out the necessary amount of heat to keep up a bench of five retorts; a difficulty which he attributes to the fact that the rush of cold air, which seems necessary to effectually consume the tar, neutralizes, to a great extent, the heating power upon the retorts. After about a twelve-month's trial, the writer concludes, the tar-heating business was abandoned, and coke substituted, when matters worked smoothly.

——WE referred last month to the Ellis bi-sulphide of carbon, or vapor engine, and now learn that it has been introduced into a machine company's works in Fitchburg, Massachusetts. The machinery of the establishment is operated by a 6 x 9 steam-engine, under a pressure of 65 pounds. With the exhaust of this engine the bi-sulphide of carbon is boiled, and with its vapor a second engine of 8-inch cylinder with 11-inch stroke is actuated. The power is not only applied to the immediate use of the factory, but is conveyed by means of a 254-foot wire cable to a neighboring establishment. For this service the company receives a sum about equal to that which it costs to produce the steam for the steam-engine; so that, that which would otherwise be clear waste, is here turned into gain. It is further stated the vapor engine, when once in complete order, worked with literally no stoppages other than were desired, and that the total leakage for a period of over four months was less than one gill per 24 hours. At the expiration of the whole time during which the machine was in continuous use—about eight months—the manufacturers, desiring to replace it with one of newer and more improved form, sold it for cost price; a careful examination of all its parts by the purchaser proving that no portion had become deteriorated or injured.

——HAGER suggests the following formula for the preparation of a starch which shall render fabrics incombustible: At first, 50 parts of hot water are poured over 10 parts of white burned bones ground to a fine powder, and to this 6 parts of sulphuric acid is gradually added. The mixture is well stirred, and kept in a warm place, where it is also stirred from time to time for two days, after which 100 parts of distilled water are added, and the solution filtered. The filtrate, which contains the soluble phosphate of lime, has added to it 5 parts of the sulphate of magnesia, dissolved in 15 parts of distilled water. Enough ammonia is next stirred into the cold solution to give it the smell of ammonia. The precipitated double phosphate of ammonia and magnesia is collected on a linen filter, pressed and dried in a moderately warm place, and then reduced to a powder. Two parts of this powder are then mixed with one part of tungstate of soda and six parts of wheat starch. Care must be taken that no iron enters into the materials of the manufacture. To use this powder it is mixed with twice its quantity of cold water, and then enough boiling water stirred in to form a slimy liquid, in which the goods to be protected are immersed.

——A SIMPLE fire-alarm for use in the household, which appears to be quite practical, has been suggested by Dr. Van der Weyde. It consists of a small weight of lead or iron, which is caused to adhere to the ceiling of each room with a piece of wax. Should the temperature thereupon become unusually elevated in any part of the building, the wax with which the weights are held will loose its adhesiveness, and allow one or more of the weights to drop. It is also designed that each of the weights should be attached by wires to the bells of the house, or to any othe signal introduced for the purpose. In falling, therefore, the alarm must be given. It is, of course, necessary to avoid placing the weights in the immediate neighborhood of stove-pipes, and one of them should be placed in each room and hall-way.

——The following is a new method of mounting sterescopic views by Professor Himes: Instead of affixing the photographic prints to the usual stiff cards, they are mounted in a book about 3⅜ by 3¼ inches, on leaves of heavy paper of double that size, fastened by their centres on short guards, like maps in an atlas, each book containing about a dozen such double leaves. A piece of smooth paper is placed between the halves of each stereograph after mounting, and the book subjected to pressure, as of a copying press, for an hour or more. By opening such a book at any of these double leaves, and sliding it between the wire guards of a Holmes stereoscope, like an ordinary stereograph, an effect equal in all respects to that of the card stereograph is produced. Since the pictures can be readily examined by simply turning the leaves, and may be compactly stowed away, it is claimed that there is comparative freedom of the photographs from injury by mechanical, chemical, or atmospheric influence, whilst the facility of reference to any particular picture is greatly increased, especially when collections are properly arranged and classified, for which purpose each book is supplied with a blank index and title pages. It is suggested that collections of stereographs on this plan, illustrative of different subjects, scientific and others, or supplementary to books upon such subjects, might be placed in libraries, accessible to the public, with almost as little risk of injury as the books; a few simple instruments hung near such cases being the only addition necessary. The range of purely scientific subjects susceptible of stereoscopic illustration might be greatly increased under such encouragement.

——Dr. Russel, F.R.S., communicates the fact to the Chemical Society, that thoroughly washed and purified hydrogen causes a precipitation of metallic silver from a solution of silver nitrate, the precipitation occurring much more readily in saturated than in dilute solutions. The gas employed was usually procured by the action of a saturated solution of copper sulphate on zinc, or by the action of water on powdered zinc and tin. After it has passed for about half an hour through a saturated solution of the silver salt, a dull grayish deposit is produced, which is succeeded by a bright crystalline deposit. A clear solution, through which hydrogen had been passed, became turbid, and gave a precipitate of silver when heated. Similar effects were obtained when the solution was exposed to an atmosphere of hydrogen, instead of causing the gas to bubble through it. The author has conclusively proved that these phenomena are caused by the hydrogen replacing the silver in the silver nitrate, producing hydric nitrate; but a secondary reaction also takes place between the nitric acid and the precipitated silver, which results in the formation of silver nitrate. Dilute solutions of nitric acid have little or no action on silver, so that hydrogen precipitates silver as readily from a nitric acid solution as from aqueous solution. It has long been well known that hydrogen will precipitate from their solutions platinum metals and gold, and the above observation with regard to silver adds to its importance as a reducing agent.

——At the last meeting of the Franklin Institute some remarkable specimens of cold-punched nuts were exhibited from the workshop of Messrs. Hoopes & Townsend, of Philadelphia. One of the specimens referred to had a hole one-quarter of an inch in diameter and one inch deep; the other was perforated with a hole a half inch in diameter and one and a half inches deep. It has been a generally accepted rule amongst mechanics that "the maximum thickness of iron that can be punched cold is about the diameter of the punch." The specimens above referred to indicate that the old rule must be modified to meet this recent performance, seeing that the depth of the smallest nut is about four diameters of the punch, and that of the larger one three diameters. The punches used in this operation differ in no apparent respect from the ordinary punches, being made of good steel, but they are said to be hardened by some new process. In punching through considerable thickness of iron a sensible widening of the punched sample is manifest, showing clearly that some of the metal has been forced sideways.

——A patent has been granted to Mr. C. Maurice, for a form of lithographic stone for direct printing, which promises to prove quite an innovation in the art of lithographic printing. He has entirely discarded the flat stone, and by the use of diamond stone working machinery, produces a solid cylinder, from which impressions can be taken with far greater ease and rapidity. Should this innovation prove to realize in practice the advantages claimed for it, one great obstacle to the extensive employment of lithography—viz., the cost of printing—will be materially lessened.

——An indicator, to detect the presence of carbonic oxide gas in the atmosphere, has been proposed upon the following plan: A vessel, the sides of which are connected with an electric battery, is supplied with a solution of chloride of palladium; the wires are so adjusted that, so long as no metal is precipitated, electrical contact is incomplete. So soon, however, as carbonic oxide makes its appearance in the atmosphere, metallic palladium is precipitated from the solution contained in the indicator. The effect of this precipitation is to establish the electrical current; a bell is instantly rung, giving notice of the presence of the injurious gas. The practicability of such an arrangement, it is plain, will depend entirely upon the ability of carbonic oxide to reduce the salts of palladium, a reaction which may occur, but which we have nowhere seen stated. It is well known, however, that hydrogen gas, when led through, or kept in contact with solutions of any of the platinum metals, will completely reduce them to the metallic state; but, in this case, the hydrogen simply replaces the metal in the compound, furnishing one of the simplest examples of the substitution of one element in a compound for another. The reaction of carbonic oxide, however, with salts of the platinum metals, could, if genuine, bear no resemblance to that of hydrogen, and would be of so curious a nature as to involve the practicability of the apparatus in considerable doubt.

——A statement has been very extensively circulated by the scientific press that a Philadelphia firm contemplate, the construction of a wrought iron tower 1,000 feet in height, which is to be erected in Fairmount park as a feature of the Centennial exposition of 1876. We do not know upon what authority the statement is made, but simply state it as it has been circulated. Dimensions of the proposed structure are represented as follows: Height, 1,000 feet; diameter at base, 150 feet; diameter at top, 30 feet; section circular. The slope of sides, with the dimensions as stated, will be 1 ft. in 8.33. In addition to the detail of dimensions the informaiion is given that the interior will be provided with a spiral staircase winding about the central tube, for the benefit of those desiring to walk to the top; while elevators will be likewise provided for the ascent. Should this remarkable declaration be verified, the tower will be by far the highest construction ever reared by man upon the face of the earth. The highest pinnacle now in existence is, we believe, the spire of the Cathedral of Strasbourg, which is 563 feet from the ground; but, beside the tower rearing itself to the height of 1,000 feet, this, as well as every other existing structure, would appear as dwarfs beside a giant.

——The following interesting table, representing the breaking strength of various sizes of manilla rope, has been communicated by Messrs. Riehle Brothers, of Philadelphia. The tests were made, with great care, upon one of the testing machines built by the firm for the United States navy department.

Size.	*Breaking weight.*	*Size.*	*Breaking weight.*
6 thread	625 lbs.	2¼ inch	4,250 lbs.
9 “	950 “	2½ “	4,750 “
12 “	1,375 “	2¾ “	7,375 “
15 “	1,800 “	3 “	8,000 “
18 “	2,250 “	3¼ “	9,750 “
1¼ inch	2,750 “	3½ “	11,750 “
1½ “	3,250 “	3¾ “	13,500 “
2 “	4,100 “	4 “	16,750 “

——A simple method of showing to an audience the fact of the gain in weight in burning, in an experimental way, has been employed by Mr. Theodore D. Rand, which can very satisfactorily be substituted for the elaborate pieces of apparatus which have been devised for this purpose. He takes an ounce or so of the fine turnings of zinc produced in the spinning of that metal, binds them loosely with a thin iron wire, and accurately balances them from the arm of a balance. The mass is then ignited with a match. The result is, first, that the zinc end of the balance will rise, since the combustion on the surface of the mass is quite vigorous, and great clouds of the oxide escape into the air. Soon, however, the combustion becomes a mere glow, the oxygen being absorbed quietly, and the escape of oxide fumes ceases. In about a minute the zinc end of the beam descends and remains permanently depressed.

——A PATENT has recently been issued in France for a new alloy, which is said to resemble silver more closely than any imitation yet devised, with respect to color, specific gravity, malleability, ductility, and other physical properties. The new alloy is quite complex in its constitution, containing copper, nickel, tin, zinc, cobalt, and iron. The following are the proportions for the production of a compound white metal perfectly resembling silver, viz.: Copper, 71 per cent.; nickel, 16.50 per cent.; cobalt, 1.75 per cent.; tin, 2.50 per cent.; iron, 1.25 per cent.; zinc, 7 per cent. As much of the zinc is volatilized in the manufacture, but a trifling percentage of it remains in the finished product. The superiority of the alloy is said to be due principally to the presence of cobalt, which affords to it its peculiar argentine lustre.

——PERHAPS the largest water-wheel in the world is that at Laxey, Isle of Man—a locality famous for centuries for its silver, lead, and copper mines. The deepest workings lie some 450 yards below the surface, and are kept dry by the wheel referred to. The wheel, built by a resident engineer, is called the Lady Isabelle, and has been in operation since the 27th of September, 1854. The duty of the wheel is about 200 horse-power, and can discharge 250 gallons of water per minute from a depth of 400 yards. The diameter of the wheel is 72 feet, its width 6 feet. A second enormous water-wheel is in this country, and serves to run the Burden iron works at Troy, New York. It is an overshot wheel, of 50 feet diameter and 22 feet width.

——THE largest piece of ordnance ever made in this country was successfully cast a few days since at the West Point foundry. The gun is being constructed to test the value of certain ideas of the inventor. In the rough state the casting weighed 72,000 pounds. It is 19 feet in length, but will be reduced to 15 feet when finished. It will then have a steel barrel 4 inches in thickness at the breech, and 3 inches at the muzzle, with rifle bore, and will weigh 45,000 pounds. The ball will be 9 inches in diameter, and will weigh about 250 pounds.

——CRUDE petroleum has been employed in brick kilns, instead of coal or wood. By a simple contrivance the nozzle of the burner is made to throw the flame directly downward at the first firing, and after burning the head (as it is termed), this nozzle is replaced by a straight one—the change being effected in a few minutes. The flame is thereby thrown into the arch any required distance, burning the whole kiln from one end. One man, by this process, it is claimed, will be able to do as much firing as a dozen with the old.

——A PHILADELPHIA inventor has succeeded in so perfecting the art of manipulating, disintegrating, and otherwise treating asbestos, that he has been able to produce, and is now manufacturing therefrom, paper and board of various degrees of thickness and quality, (either entirely of asbestos, or in part of paper pulp,) and a woven fabric, which is strong, takes color well, and is quite incombustible. We shall reserve further particulars of this interesting circumstance for a subsequent number of the Review, when we will treat of it at length.

——IN the recently issued report of the British inspector of factories, Mr. Baker, mention is made, among other matters of moment, of the fact that gas engines are growing in use in quite a number of trades, especially for small letter-press printers and riband weavers. Whenever a solid foundation for the engine can be attained it is a cheap and easily applied motive power. In one of the districts of England, largely devoted to the riband-weaving industry, this form of motor has been largely substituted for the labor of boys with very successful results.——A FRENCH scientist has, upon investigation, announced the discovery, that while the quantity of carbonic acid in the atmosphere decreases with considerable regularity as one rises from the earth's surface, the quantity of ammonia, on the contrary, is increased. The experiments were conducted on the Puy de Dome and the Puy des Sauëys, in the Auvergne.——A RECENT English patent is upon an improvement in the manufacture of cement, and consists in mixing the refuse or foul lime from the gasworks with any marl or fine clay containing the necessary quantity of silica and alumina, in the proportion of about from 70 to 80 parts of the lime to about 30 or 20 parts of the clay in every 100 pounds of material. The proportions above named, however, may be varied according to the quality of the lime and the quantity of sulphur which it contains.——IT is authoritatively stated that the Cunard Steamship Company is at present having constructed a steamship which will be the largest vessel of its class afloat, with the single exception of the Great Eastern.

——THE state of British engineering industries at the close of the year is thus depicted by the British Trade Journal: "The situation of engineering and its allied industries shows no indications of improvement. The dulness which usually attends the close of the year in the minor branches of metallic manufactures is intensified in nearly all quarters by the prospect of coming struggles between labor and capital. The year on which we are entering will probably witness a renewal of those differences between employed and employers which never operate to the advantage of trade, and the bitterness of which is likely to be further increased by the introduction of a political element. Rumors of strikes and lock-outs, though scattered and few, are not altogether wanting; and should the present slackness in demand, both, at home and abroad, continue far into the year, half time and lower rates of wages, either or both, may precipitate a conflict which is usually sooner begun than ended. The Bessemer steel manufacture, which has maintained its ground in a weak market for some time, has at last given way; foreign makers, it is said, underselling us £3 a ton. This difference is mainly due to the lower rate of continental wages. Messrs. John Brown & Co., of Sheffield, have therefore given their employés notice of a reduction of 10 per cent., which has been followed by the strike of 1,500 of their mill and forge hands. Messrs. Firth, of the same town, the leading steel firm in the kingdom, are minimizing time, labor, and machinery; and the action of another large firm like Messrs. Cammell & Co. would, it is thought, make a wage reduction general. In London, the operative engineers, under the influence of their "Conference," are agitating for an increase of 2s. to the present minimum rate of 36s. a week. Several firms in the metropolitan district have conceded the demand; but among the abstentions, Messrs. Blythe, of Poplar, have answered a notice of strike on the part of their hands by a lock-out, throwing 100 men on the resources of the trade society; a prompt proceeding, which, it is thought, will be followed in other factories. Machine shops are not altogether inactive, though nothing like briskness prevails—the work in hand being mostly small, and the balance of untimed orders. Dependent on the absence of any great disturbance, political, financial, or commercial, we may reasonably look forward, however, to a season of improvement when the new year has fairly begun. The requirements of construction on the continent are large; the success of railway extensions, tramways, and other undertakings for which bills have been lodged with parliament, as well as the not improbable reformation and improvement of existing railway material, should the Board of Trade continue its pressure on the companies, will create a demand which it will depend a great deal on the temper of our operatives whether the engineering trades are able to supply."

——A FIREPROOF joist has been invented in England, says Iron, for which are claimed many advantages. It is as strong as the ordinary joist, if not stronger, consisting of a slip of wood five inches wide by five-eighths of an inch thick, bolted between two flanged strips of quarter-inch iron. An ordinary joist of eleven inches by three can be cut up into eight of this pattern. The iron sides, besides affording strength, are claimed to render the joist practically fireproof, while the centre of wood affords the means of putting down floors in the accustomed manner, and gives the usual facilities for lathing, so that the architect has at his disposal precisely the same basis for ornamentation as if ordinary joists were used. The obstacle to the manufacture of these joists has hitherto been the difficulty of rolling the flanged iron sides, but this has been successfully overcome, and thus an opportunity is afforded of testing the merits of the invention by employing it in some structure.

——As a producer of aniline colors, Germany is far in advance of the rest of the world, making as much as all the remainder of Europe taken together. In the year 1872 the value of these colors there manufactured amounted to over seven millions of dollars, and the manufacture is very greatly extending. But even this enormous production, it is said, is entirely cast into the background when compared with the gigantic development of the trade in artificial alizarine. Though the possibility of its production by artificial means was only demonstrated in 1868, the production in Germany during the year 1873 reached the figures of 1,100 tons, with a value of $3,000,000; and it is announced that one single establishment of Germany, where there are ten or twelve in all, is preparing for a production of 5,000 tons of alizarine paste per year.

MONETARY.

THE old year went out and the new came in with financial features suggestive of less use, and consequently less want of money—somewhat lower prices, too, have contributed an influence towards monetary ease. There is considerable seeking of investments, and municipal bonds do not seem to be in better favor than those of well-established railroads; there are no new railroad bonds to compete with the old ones and discredit them, but the default of some companies in payment of their loan interest forces closer scrutiny in the selection. In and out of congress, currency theories continue to be broached, and while each speaker or writer deems that he has got the grand specific to cure the disease (which never includes the paramount question of exchange), the let-alone-policy gains adherents, and is maintained by the opposing views of those who believe the necessity is imperative to do something. The condition, workings, and speculations of the banks receive new attention, and the pertinent question is started as to how much suspended paper is held by these institutions, and published as assets against liabilities. While the public debt is increasing, it is yet now presumed that the period of revenue deficiency will be limited, and this strengthens the opinion that temporary expedients are all that is needed by the government.

The National board of trade, assembled at Baltimore, has suggested that congress, in effect, do two things, if the board is correctly reported, viz.: 1st, declare that the federal bonds, hypothecated for National bank note circulation, are insufficient security; and, 2d, enhance the premium on gold. The shape which these suggestions take is as follows: The board recommends that congress be requested to so amend the national banking law that the banks shall be compelled to hold the coin they receive for the interest on their bonds hypothecated as security for their circulation as a part of their reserve, until their reserves in coin shall be equal at least to thirty per cent. of their circulation.

——*Sales of Stocks, etc., at New York.*

	Dec. 29.	Jan. 5.	Jan. 12.	Jan. 19.
U. S. 6's, coupon, 1881	120	*117	117½	117⅝
" 5-20's, coupon, 1862	113½	113½	114	113⅜
" 5-20's, coupon, 1864	115	114¼	116	115½
" 5-20's, coupon, 1865, m & n	115½	115	116½	116⅝
" 5-20's, coupon, 1865, j & jy	118¼	*115	115⅞	115⅝
" 5-20's, coupon, 1867	119¼	*116	116⅞	117
" 5-20's, coupon, 1868	119	*116	116¼	116½
" 10-40's, coupon,	112⅛	113¼	113¾	113¼
Pacific 6's, currency	113⅝	114	114⅜	114½
Tennessee 6's	....	80½	80⅜	....
" 6's, new	....	80½	80½	....
North Carolina 6's	....	....	....	....
" 6's, new	....	....	....	....
Missouri 6's	....	....	94⅞	....
N. Y. Central and Hudson R. con	98⅛	100⅜	101⅞	102⅝
Harlem	119	119½	125	125
Erie	44½	47¾	47¾	48⅝
Lake Shore and Michigan Southern	76⅛	81¼	82⅞	80⅛
Wabash	48⅝	53⅜	53⅞	53⅞
Cleveland and Pittsburgh	84½	86	86⅜	88½
Northwestern	56	60¾	61⅜	60¾
" preferred	....	....	73	......
Rock Island	99¾	104¼	104⅞	104⅝
Fort Wayne	86½	....	90	90
Milwaukee and St. Paul	41¼	45½	48¾	48
" preferred	....	....	....	....

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* Ex coupon.

	Dec. 29.	Jan. 5.	Jan. 12.	Jan. 19.
Ohio and Mississippi	30	32	35⅜	33⅞
New Jersey Central	102	99	99¾	99½
Western Union Telegraph	72⅛	76¼	78¼	75⅞
Pacific Mail	38	41⅜	42⅝	42
Union Pacific	30⅛	30⅝	34⅜	34⅝
Adams Express	91½	93½	92¾	93
Wells, Fargo & Co. Express	66	69	69	69
American Merchants Union Express	57½	60	60	60½
United States Express	67	70¾	70¾	70
Rate for Money	7	7	6	5@7

Sales of Stocks, etc., at Philadelphia.

Gold	110⅛	111½	112	111⅛
Sterling Exchange	120½	5.38½	5.41½	5.39
Paris Exchange	4.65	4.67½	4.59	4.62½
Lehigh Valley Railroad	57¼	59	58½	58¾
“ “ 6's	94	94¼	95	96½
“ “ 7's, reg	94½	95½	97	99¼
Lehigh Navigation	41½	42¾	42⅝	41¾
“ “ 6's, 1884	90	90½	93¾	94
“ “ 6's, g ln	90¼	91¼	93	93½
“ “ 6's, reg	91	91	92¾	94
City 6's, no tax	100⅞	101⅞	101¾	101⅞
“ tax	95	97	98	98
Pennsylvania Railroad	46¾	48¾	48⅜	48
“ “ 6's, 1 m	100	98¾	99½	99¾
“ “ 6's, 2 m	97	97	99¼	99¾
Pennsylvania 6's, first series	....	100	....	....
“ 6's, second series	107	....	104	105½
“ 6's, third series	109	....	106	107
Reading Railroad	57	*55⅛	56⅝	55½
“ “ 6's, mt	97	95	94	97
“ “ 7's, reg	100	101	101⅝	102½
Catawissa Railroad	18½	....	18	17¾
“ “ preferred	42	42⅜	42½	42½
North Pennsylvania Railroad	46	45	44	....
“ “ “ 6's, mt	100	....	96	97½
“ “ “ 7's, mt	100	100¼	101	101¾
“ “ “ 10's, chat	105	106	106½	107
United N. J. Companies	116	116	118	120
Camden and Amboy 6's, mt	92½	94	94½	95½
“ “ 6's, 1883	....	....	....	....
“ “ 6's, 1889	....	....	....	....
West Jersey Railroad 6's	93	....	....	....
“ “ 7's	101	101	101½	101
Philadelphia and Erie	23	23	23½	23
“ “ 6's	87	....	90	90
Allegheny County 5's, coupon	....	....	75	75
Schuylkill Navigation	6	6	6¼	6⅜
“ “ preferred	12	12¼	12¾	12¾
“ “ 6's, 1882	....	70	72¼	74
Morris Canal	45	....	....	....
“ preferred	....	120	120	122
“ 6's, 1882	89	90	92	94
Little Schuylkill Railroad	46½	47	46	46
Oil Creek and Allegheny Railroad	19	17½	17½	16¾
“ “ “ 7's	62	63½	63½	....
Philada., Germ. and Nor. Railroad	85	87	87	....
Minehill Railroad	50	53	50	51
Elmira and Williamsport, preferred	....	....	35	35
“ “ 7's	....	93	92	95
“ “ 5's	50	....	58	....
Northern Central	29	....	29½	....
Rate for Money	6	6	6	6

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* Ex dividend.